THE EFFECTS OF CONSOLIDATING F-16 PHASE AND CANNIBALIZATION AIRCRAFT ON KEY MAINTENANCE INDICATORS

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This study investigates the potential improvement in aircraft fleet health resulting from consolidating phase and cannibalization aircraft in the 388th Equipment Maintenance Squadron at Hill AFB, Utah. Never before have these programs been consolidated into one centrally managed facility. The focus of the study is to determine if the impact of consolidating F-16 phase and cannibalization aircraft on key maintenance indicators warrants program implementation Air Force wide. The key maintenance metrics of the 388th Fighter Wing's F-16 aircraft fleet prior to the start of the program are compared to the same metrics following program implementation. These metrics are then similarly compared to those of the other active duty F-16 fighter wings throughout Air Combat Command to assess measurable differences in performance. The secondary and tertiary benefits of implementation are also discussed to lend additional support to the program. The study identifies the critical factors leading to this program initiative, the benefits gained, and the sufficiency of the program in today's operational environment. This study promotes this program as an Air Force Smart Operations for the 21st Century initiative. The adoption of the program is recommended to improve the overall fleet health and operational readiness of the Air Force's aircraft inventory.

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The opinions and conclusions expressed herein are those of the student author and do not necessarily represent the views of the U.S. Army Command and General Staff College or any other governmental agency. (References to this study should include the foregoing statement.)

ABSTRACT

THE EFFECTS OF CONSOLIDATING F-16 PHASE AND CANNIBALIZATION AIRCRAFT ON KEY MAINTENANCE INDICATORS, by Major Matthew J. Powell, USAF, 89 pages.

This study investigates the potential improvement in aircraft fleet health resulting from consolidating phase and cannibalization aircraft in the 388th Equipment Maintenance Squadron at Hill Air Force Base, Utah. Never before have these programs been consolidated into one centrally managed facility. The focus of the study is to determine if the impact of consolidating F-16 phase and cannibalization aircraft on key maintenance indicators warrants program implementation Air Force-wide.

The key maintenance metrics of the 388th Fighter Wing's F-16 aircraft fleet prior to the start of the program are compared to the same metrics following program implementation. These metrics are then similarly compared to those of the other active duty F-16 fighter wings throughout Air Combat Command to assess measurable differences in performance. The secondary and tertiary benefits of implementation are also discussed to lend additional support to the program.

The study identifies the critical factors leading to this program initiative, the benefits gained, and the sufficiency of the program in today's operational environment. This study promotes this program as an Air Force Smart Operations for the twenty-first-century initiative. The adoption of the program is recommended to improve the overall fleet health and operational readiness of the Air Force's aircraft inventories.

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TABLE OF CONTENTS

ACRONYMS

ACC	Air Combat Command
AFB	Air Force Base
AFSO-21	Air Force Smart Operations for the 21st Century
AMU	Aircraft Maintenance Unit
AMXS	Aircraft Maintenance Squadron
CLR	Chief of Staff of the Air Force's Logistics Review
CMS	Component Maintenance Squadron
CONUS	Continental United States
CSAF	Chief of Staff of the Air Force
CWO	Combat Wing Organization
EMS	Equipment Maintenance Squadron
FMC	Fully Mission Capable
MC	Mission Capable
MICAP	Mission Capability
MXG/CC	Maintenance Group Commander (O-6 or Full Colonel in USAF)
NMCB	Nonmission Capable for Both (Maintenance and Supply)
NMCM	Nonmission Capable for Maintenance
NMCS	Nonmission Capable for Supply
O & M	Operations and Maintenance
OTI	One-Time Inspection
OWM	Objective Wing Model
PAA	Primarily Assigned Aircraft
PMC	Partially Mission Capable

PMCB	Partially Mission Capable for Both (Maintenance and Supply)
PMCM	Partially Mission Capable for Maintenance
PMCS	Partially Mission Capable for Supply
SECAF	Secretary of the Air Force
TCI	Time Change Item
TCTO	Time Compliance Technical Order
1 FW	1st Fighter Wing (Langley Air Force Base, Virginia)
388 FW	388th Fighter Wing (Hill Air Force Base, Utah)

ILLUSTRATIONS

TABLES

CHAPTER 1

BACKGROUND AND INTRODUCTION

Background

Since the end of the Gulf War the US's military budget has been on a rapid decline. The impact to readiness and morale has been alarming and has launched the US military into what some say is a state of crisis. Largely the blame has been put on President Clinton and former Vice President Gore. As evidence of the "Peace Dividend" resulting from the end of the Cold War, throughout the Clinton and Gore Administration, the military budget was underfunded more than $300 billion in cumulative dollars, and at the same time the number of deployments for military members increased from 30 deployments from 1983 to 1993 to 136 deployments from 1993 to 2000.[1] The combination of these two factors caused huge backlogs in maintenance, overhauls, and long-term health of the aircraft and equipment fleet maintained by the US military.[2]

One area where the budget shortfalls have caused significant impact is the spare parts budgets for aircraft. According to the 1999 *Annual Defense Report to Congress and the President*, defense spending on the operations and maintenance budgets (the part of the budget used for spare parts and depot maintenance) declined steadily following the end of Desert Storm.[3] Table 1 shows operations and maintenance budgets for fiscal year (FY) 1992 through FY 2000 in current year dollars, constant year dollars, and percentage of real growth or decline in the budget.[4]

Table 1. Operations and Maintenance Budgets FY1992 through FY2000

Fiscal Year	**Current Dollars**	**Constant FY2000**	**Percent Real Growth**
1992	$93,791	$109,807	-20.3
1993	$89,172	$101,674	-7.4
1994	$88,341	$98,400	-3.2
1995	$93,751	$102,352	+4.0
1996	$93,658	$99,988	-2.3
1997	$92,353	$96,467	-3.3
1998	$97,215*	$100,672*	+2.9
1999	$98,059*	$99,805*	-.9
2000	$103,534*	$103,534*	+3.7

*budget data is from FY2000 Annual Report. All others from FY1999 Annual Report

With the exception of FY1995, FY1998, and FY2000, the budget declined steadily throughout the Clinton and Gore Administration. The administration was not alone in the decisions that helped to impact the readiness of the Air Force's aircraft fleet. The Air Force senior leadership bears some responsibility too as they made the decision in the mid-1990s to purposefully reduce funding for spare parts and depot maintenance in order to fund other programs.[5] Their belief was "While not a desirable long-term strategy, the AF believed that innovation and careful management would allow it to maintain equipment at lower levels of funding."[6]

These decisions, coupled with underfunded budgets and an increased operational tempo, pressured the US military to rely on undesirable practices to continue to meet its mission. Among these practices is the act of cannibalization. Cannibalization, as defined by the Pentagon, is, "The act of removing serviceable parts from one piece of equipment and installing them in another to make repairs that would otherwise be unattainable."[7] The US Air Force and Navy rely very heavily on cannibalization to ensure they are able to maintain the proper level of readiness to fight America's battles when called upon. They have become so reliant that it has simply become routine. In fact, from FY1996 to FY2000 it is estimated the US Air Force and Navy made more than 850,000 cannibalizations utilizing more than 5.3 million man-hours.[8] While this practice affords maintainers the opportunity to repair a broken aircraft more quickly when a needed part is not in their on-base supply system, the practice is undesirable because cannibalizing takes twice as many maintenance man-hours to make a repair. For instance, to cannibalize a part for a single aircraft system discrepancy, maintenance personnel must first remove the broken part from the unserviceable aircraft. Second, maintainers must remove a serviceable part from the donor aircraft or cann jet. Next, they must install the serviceable part from the cann jet into the unserviceable aircraft. And then ultimately they must install a new serviceable part into the cann jet when the new part comes in through supply channels.[9] The bottom line is the maintenance repair needs to be accomplished twice--a very time consuming and inefficient maintenance process. Additionally, cannibalizing parts from a cann jet increases the wear and tear on the cann jet itself.

A quick and easy solution to this problem for the military is for the United States Congress to fully fund the military's budgetary requests. This sounds simple right? The problem is the ripple effect this scenario has on the rest of the US budget. In these days of zero sum budgets and apprehension toward deficit spending, if the military received full funding then several other government programs go without. This is an unlikely scenario. As stated above, the military budget was not fully funded by Congress for at least the last fifteen years. In addition, it is well documented that the United States armed forces are not likely to encounter a peer competitor before the year 2020.[10] This allowed Congress to place emphasis, and in turn budgetary dollars, toward other programs, forcing the military to re-look at justification of its programs for future year budgets. Until the budget is fully funded for modernization, future aircraft acquisitions, and serviceable spare parts, the military will continue to rely on cannibalizing parts in order to meet mission requirements. However, at least one fighter wing has developed an innovative approach to alleviate the spare parts problem and still increase its mission capability rates at the same time.

In August of 2001, the Commander of the 388th Fighter Wing (388 FW) asked his key leaders to look at two ideas. His first request sought to evaluate the feasibility of consolidating three individual squadron cannibalization aircraft into two wing cannibalization aircraft. His desire was to improve the wing's key maintenance metrics and to provide one more flyable aircraft to the wing for flying training. The wing's implementation team went about the task of fulfilling the wing commander's request. Simultaneously, in fulfillment of the Chief of Staff of the Air Force's request, the 388 FW, in conjunction with several other bases throughout the USAF, was testing several facets of the Chief of Staff of the Air Force's Logistics Review (CLR). The 388 FWs portion of the CLR included a test to realign the three fighter squadron aircraft inspection facilities under the Equipment Maintenance Squadron in order to enhance the health of the fleet, improve the quality of the inspections, and increase the speed by which inspections were accomplished. The wing commander did not want any testing in support of his request to interfere in any way with the CLR testing.

As a second request, the wing commander sought to evaluate the manpower utilization of the aircraft inspection section to identify any hidden capacity of those personnel. He was convinced there was hidden capacity of the personnel working in these sections. And he sought to utilize this perceived hidden capacity in a way beneficial to the health of the fleet of the wing's aircraft.

The wing commander chose two captains, both career aircraft maintenance officers (one of them the author of this thesis), to spearhead the evaluation and find the best process to achieve his requests. Several months of data gathering, study, evaluation, and development of courses of action ensued. The evaluation team also studied the ongoing CLR testing. Ultimately, the evaluation team determined the best course of action to fulfill the wing commander's request was to consolidate the three squadron cannibalization aircraft into two wing cannibalization aircraft. The evaluation team also determined these two wing cannibalization aircraft should be co-located within the existing infrastructure and organization of the phase aircraft inspection section to take advantage of economies of scale with manpower, tools, equipment, and processes.

Purpose of the Study

The purpose of this study is to evaluate the results of this program change and determine the effects of consolidating F-16 cannibalization and phased aircraft on key maintenance indicators for the 388 FW. The following areas will be examined to answer the research question:

1. What are the key maintenance metrics for the F-16 aircraft?

2. Will this program be suitable for bomber, tanker, cargo, and special mission aircraft?

3. What other maintenance environment issues affect the key maintenance indicators?

4. Will the results be greater or less than expected?

5. Has this been tried before? Where? How well did it work?

6. What is the effect if the program goes away?

7. What are the second and third order effects of consolidation?

Assumptions

The researcher's use of historical maintenance indicators both prior to and following the change to a consolidated phase and cannibalization facility will reliably measure the impact of this operational change. Though the 388 FW and the other fighter wings in ACC deploy many different locations from year to year and take different numbers of aircraft on each of these deployments, the researcher assumes the operational tempo of theses fighter wings remained relatively constant throughout the six-year evaluation period. The researcher assumes leadership changes in the maintenance groups throughout ACC occurred at the same relative interval as the 388 FW did throughout the evaluation period. While all leaders and their capabilities are different, the researcher assumes all leaders in the Maintenance Groups throughout ACC met minimum standards and further that every wing had an equal chance of gaining "well above standard" or "just above standard" maintenance group commanders. Supply system priorities are higher for deployed aircraft than they are for Continental United States (CONUS) based aircraft, however the researcher assumes all the supply system priorities for CONUS-based aircraft are constant.

There was a significant change made in 2002 in the way the Air Force organized its air wings. This gave the maintenance community responsibility for all day-to-day maintenance activities and the long-term sustainment of the aircraft assigned to its wings.

Maintenance leaders are trained experts in the proper management of fleet health whereas the operations personnel who held responsibility for some of these activities previously were not. Due to this fact, an increase in the maintenance metrics for most aircraft types was an expected result. Accordingly, I must assume the impact to the maintenance metrics of all wings was the same or constant.

An additional assumption involves the mitigating factors that vary in the F-16 fleets in the 388 FW at Hill AFB, UT and the other F-16 bases in ACC. There are several mitigating factors that can impact a wing's maintenance metrics. Some but not all of them are:

Manpower. Variance of the number of personnel assigned and their experience/skills

Aircraft Age. Age of the fleet measured in years and flying hours as well as the speed of the accumulation of those flying hours

Leadership and Morale. Leadership at all levels impacts morale as well as the way in which aircraft are flown, scheduled and repaired and how maintenance personnel are employed to repair them. Some leaders are phenomenal, some meet the standard and still others fail to meet the standard.

Aircraft Mission. Different block models of F-16s perform difference missions and may impact maintenance metrics

Weather Conditions. Warm/humid climates with mild winters impact airframes in different ways than a predominantly desert climate with hot/dry summers and cold/snowy winters

Operational Tempo. With respect to involvement in contingencies and deployments

Additional Programs in the 388 FW or Other Bases. Some maintenance programs may be different from wing to wing due to leadership or other factors. As a result there is no method by which I can account for any impact these programs may have on key maintenance indicators without performing another study.

Therefore I had to make several assumptions to assess these factors as constant within each wing and within ACC for the purposes of comparison. Accordingly, any difference in positive or negative performance in the 388 FW compared to ACC was attributed to the consolidated phase and cannibalization program. I have not assumed these factors and problems away, but addressing these issues would be beyond the scope of this thesis and therefore were not factored into the assessment.

Definitions

Aircraft Break Rate: The percentage of time an aircraft returns from a sortie with a system anomaly or discrepancy

Cann Aircraft or Cann Jet or Cann Bird: An aircraft specifically designated for a period of time as the source for all cannibalized aircraft parts

Cannibalization: The taking of serviceable aircraft parts from one serviceable aircraft and placing them in another unserviceable aircraft to make it serviceable

Cannibalization Rate: The number of times any aircraft part is cannibalized by a particular unit in a given month divided by the number of aircraft sorties flown by that unit in that month

Eight hour fix rate: The percentage of time an aircraft discrepancy is able to be repaired in less than eight hours

Hangar Queen: An aircraft that has not flown a sortie in more than thirty days. Hangar queens are further classified into three distinct categories. A Category I hangar queen is an aircraft that has not flown in more than thirty but less than forty-five days. A Category II hangar queen is an aircraft that has not flown in more than forty-five but less than sixty days. A Category III hangar queen is an aircraft that has not flown in more than sixty days.

Maintenance Metrics: The key maintenance indicators used to assess a particular wing's aircraft fleet health and are measured on a monthly basis

Mission Capable Rate: The percentage of time an aircraft is fully capable of performing its full range of missions

Nonmission Capable for Both Rate: The percentage of time an aircraft is not capable of performing its full range of missions due to both a supply and a maintenance problem

Nonmission Capable-for Maintenance Rate: The percentage of time an aircraft is not capable of performing its full range of missions due to a maintenance problem

Nonmission Capable-for Supply Rate: The percentage of time an aircraft is not capable of performing its full range of missions due to a supply problem

Phase Aircraft or Phase Jet: Aircraft undergoing a phase inspection

Phase Dock: The area or hangar where an aircraft phase inspection is performed

Phase Inspection: The five day inspection process performed on individual F-16 aircraft after each aircraft has accumulated a certain number of flying hours. Currently the time between phase inspections for F-16s is 400 flying hours.

Limitations

Research into this particular study will be complicated by the fact that there is only one other known aircraft wing utilizing a consolidated wing cannibalization concept and that wing's concept did not include colocating cannibalization and phase aircraft so a comparison to another identical program will be not be possible. Secondly, the program at Hill Air Force Base, Utah, began on 5 August 2002, just two months prior to the Air Force's change from the Objective Wing Concept to the Combat Wing Organizational structure, so the researcher must assess the impact of the organizational structure change along with the change in operation. Lastly, this study is limited to F-16 fighter aircraft only so comparisons of results to other fighter, bomber, cargo, or special mission aircraft will not be addressed.

I must also address the limitations in the data provided by both the 388 FW and ACC. I was reliant on the data provided by both ACC and the 388 FW as the single source providers of the information. The 388 FW does not have maintenance metric data prior to FY2001. This limited me to comparing only the last six years of metrics as opposed to the eight year comparison. There were also differences in the way the data was compiled. The ACCs ten year lookback product was configured only with annual metrics while the 388 FWs data consisted of month-by-month data. In order to properly compare ACCs data to the 388 FW, I needed to manipulate the 388 FWs data into annual metrics. This, in essence, was an average of the averages since a reformulation of the raw data was not possible. ACCs product also did not allow for the 388 FWs annual data to be removed for comparison purposes, so this too must be considered when comparing the data.

Delimitations

The research will not address other fighter aircraft (A-10, F-15, or F-117) as each fighter aircraft has a different mission, various different systems, and a different need for cannibalization of aircraft parts. The research will focus only on the impact of this program on the key maintenance indicators and will not address manpower or cost savings associated with the program.

Significance of the Study

Cannibalization of parts from one aircraft to another is an undesirable yet effective practice in the aircraft maintenance business. It has long been used as a short-term remedy for supply shortages. While this practice continues, the US military is looking for ways to stretch the defense budget to maximize its capabilities for the Global War on Terror. An example of this is the Chief of Staff of the Air Force's initiative to implement the Air Force Smart Operations for the 21st Century (AFSO-21) program in January 2006.[11] The AFSO-21 program is designed to utilize the Lean and Six-Sigma processes prevalent in civilian industry and incorporate them into the daily activities of the Air Force. The program seeks innovative processes and smart ideas to make the service more efficient. This in turn will provide the opportunity for the Air Force to get more value from its defense budget. The other services are incorporating similar programs to accomplish the same objectives.

The consolidated F-16 cannibalization and phase aircraft program at Hill Air Force Base, Utah, may be one of those critical processes to help maximize efficiency. The researcher attempted to evaluate the impact of consolidating F-16 cannibalization and phase aircraft on the key maintenance indicators used to track fleet health. The research could prove beneficial in providing a model for the aircraft maintainers across the Air Force to use as a means to save money, manpower, and time while maintaining the health of their aircraft fleet.

Background on the Changes in the Air Force Organizational Structure

It is critically important to have a grasp of three important topics before moving on in this research study. The first is that the Air Force was organized under two different organizational concepts in the last fifteen years. The first organizational structure was the Objective Wing Organization which began shortly after the end of Operation Desert Storm and lasted until 1 October 2002. The second organizational structure is the current organizational structure which is the Combat Wing Organizational structure.

The second topic that must understand is the actions and decisions involved in the management of cannibalization aircraft in the AF. The changes in the AF's organizational structure affected how the cannibalization process was managed and which agency was responsible for its management.

The third topic one must understand is the differences in the phase inspection process, the organization of its personnel and the agency that the phase inspection was assigned to under both the OWM and the CWO.

I also felt it was important to gain a more in-depth understanding of the specific changes made to the 388 FWs organizational structure and phase and cannibalization management processes before moving on to the results and analysis of this study. The following pages and the information contained in them are not cited from specific sources and instead are written directly from my experience as an aircraft maintenance officer in several fighter wings over the last fourteen years.

The Fighter Wing Under the Objective Wing Model (Prior to 1 October 2002

Under the objective wing construct, the typical AF fighter wing had two to four fighter squadrons assigned. Each squadron consisted of twenty-four primarily assigned aircraft (PAA) and two to three additional aircraft called BAA. These BAA aircraft were an additional allocation of aircraft afforded each fighter squadron due to the ongoing requirement for each squadron to send aircraft to the aircraft depots for major overhaul, repair, or upgrades. The depot process took one-to-two aircraft out of service for up to four-to-six months at a time. Additionally, each fighter squadron had the requirement to conduct local aircraft phase inspections, based on the accumulation of a set number of flying hours, on their entire fleet. This phase process--an in-depth inspection of aircraft systems, components, and overall structural integrity--took the aircraft out of service for five-to-seven days. Fighter squadrons managed the flying hour program and tightly controlled the accumulation of flying hours on each aircraft to ensure only one aircraft per fighter squadron was scheduled for a phase inspection each week. Between phase inspections and aircraft sent to major overhaul at the depots, there were usually two-to-three aircraft out of service within a fighter squadron at any one time. The BAA was allocated to each fighter squadron to directly counter the effects of removing these aircraft from service.

Cannibalization Under the Objective Wing

Before the AF's change from the Objective Wing Model to the Combat Wing Organization Model on 1 October 2002, the cannibalization management process in all fighter wings (with the exception of the 388 FW at Hill AFB, Utah, and the 1 FW at Langley AFB, Virginia) was primarily managed by the individual fighter squadron with oversight from the Logistics Group commander. Cannibalization aircraft were strictly managed by categories. These categories directly equated to the number of days since a cannibalization aircraft had last flown. They also dictated the procedures that had to be followed to return the aircraft to fully mission capable status as well as the level of involvement to be expected from higher echelons in rectifying the aircraft's status. A Category I aircraft was an aircraft that had last flown more than 30 days ago but not more than 60 days ago. A Category II aircraft was an aircraft that had last flown more than 60 days ago but not more than 90 days ago. Lastly, a Category III aircraft was an aircraft that had not flown for more than 90 days. These categories were set up to standardize procedures as well as to deter fighter wings and squadrons from creating hangar queens.[12] The goal of every maintenance unit, and the mark of a well-managed one, was to avoid any hangar queen status.

An aircraft entering cannibalization status was flown the day prior to being placed into cannibalization status so a fighter squadron could maximize the amount of time it could be used for cannibalization before entering "Hangar Queen" status. This new cannibalization aircraft was used as the donor aircraft supporting daily flying operations as well as for the rebuilding of the old cannibalization aircraft. The removal and installation of parts from the new cann jet to the old cann jet usually took four-to-five days, including operational system checkouts. The production supervisor (usually an E-7 or E-8) was the approval authority for cannibalizing parts off of the cannibalization jet. A maintainer needing an aircraft part that was unavailable in supply would place the part on order and then request the production supervisor allow them to remove the needed part from the cannibalization jet. This was done verbally and then followed up with paperwork (an AF Form 2005). Upon receiving authorization to remove the part, the maintainer requesting it would then remove the part from the cannibalization aircraft, make the proper annotation in the aircraft historical forms and install the part on the aircraft they were repairing.

When the aircraft part that was cannibalized was received from supply, the part was then reinstalled in the cannibalization aircraft. Though this process sounds very simple, and perhaps on the surface it was, it got increasingly more complex as the process was repeated, on average, several hundred times per month. The process got even more complex when one understands that the same fighter squadron conducting daily flying operations was also the unit responsible for managing and rebuilding the cannibalization aircraft throughout the duration of its cannibalization status. Anyone associated with a fighter squadron understands the dynamic nature of daily flying operations and how many competing priorities abound. It is easy to understand how simple it is for a unit to put off the longer term issues (the proper management of a cannibalization aircraft) due to the immediacy of the short term needs (making the daily flying schedule).

In my experience this process was not well managed by most fighter squadrons. Perhaps that was to be expected when the aircraft was considered “communal property” and the proper management of it was not always well enforced. What normally ended up happening was the aircraft would not be actively managed until about two-to-three days prior to the start of the rebuild. The rebuild was timed so that the cannibalization aircraft would be rebuilt and flown around the 28th or 29th day of cannibalization status--with the 30th day as a fallback should something go awry (thus avoiding Cat I Hangar Queen status which started on the 31st day).

The visual picture of a cannibalization rebuild is a spectacle to behold. It could most aptly be described as ordered chaos. Available personnel from all aircraft maintenance specialties not actively involved in daily flying operations performed parts installations and operational system checkouts as time permitted. Often times there were up to fifteen maintainers crawling onto, into, and under the aircraft to install parts. It was a very ad-hoc process. Problems, such as incomplete or lost paperwork, parts removed but never documented in the aircraft forms, and inadvertent damage to the aircraft, resulted with the cannibalization management process. It was a rare cannibalization aircraft indeed that was smoothly rebuilt. All in all, the cannibalization process in most fighter wings became a “pick-up” game and resulted in significant headaches for wing leadership. To aid in the understanding of the organizational structure discussed above, an organizational chart depicting the typical fighter wing’s structure under the Objective Wing Concept is located at Appendix A.

Cannibalization Under the Combat Wing Organization

As mentioned above, the AF changed to the Combat Wing Organization Model on 1 October 2002. There were myriad changes affecting several agencies within the wing. Among the changes made in the organizational structure of the wing was the placement of all maintenance personnel under the leadership of the Maintenance Group

Commander. (I provided an organizational chart of the fighter wing's structure under the CWO at Appendix A).

Despite the changes in the leadership responsible for the management of the cannibalization aircraft the cannibalization management process changed very little. Only now, instead of an individual fighter squadron's maintainers managing the cannibalization jet there was an Aircraft Maintenance Unit (AMU) responsible for maintaining each cann jet. This AMU was made up of the exact same personnel that previously were part of the fighter squadron. An AMU was 'associated' but not assigned to each fighter squadron in the wing. So if a wing had three fighter squadrons prior to 1 October, 2002 it now had three AMUs that provided support to the flying squadrons during flying operations. These AMUs were assigned to the Aircraft Maintenance Squadron (AMXS). With regard to cannibalization management, one positive that came from this organizational change was that now the day-to-day management and responsibility for the status of cannibalization aircraft fell under one squadron (lead by a career aircraft maintenance officer with the requisite knowledge to manage an fleets health) instead of three separate fighter squadrons (lead by pilots with little experience in managing an aircraft fleet). This helped to create more consistent management decisions concerning the cannibalization aircraft and brought more visibility to the long term health of these aircraft. Still, despite the increased consistency and visibility on the cann aircraft, the cannibalization process for removing parts, rebuilding jets and managing the cann jet were little changed. Unlike the cannibalization process/organization, the phase inspection process changed significantly from the Objective Wing Model to the Combat Wing Organization.

Phase Inspection Under the Objective Wing

Under the Objective Wing Model, the responsibility for the Phase Inspection process conducted on aircraft was also the responsibility of the fighter squadron. Each fighter squadron maintained an Aircraft Phase Inspection Section, usually around twelve to fifteen aircraft crew chiefs, and was organized under the Sortie Support Flight (See Appendix A). Their responsibility was to perform all phase inspections on the fighter squadron's aircraft throughout the year. Aircraft phase inspections were conducted based on a set number of accumulated flying hours on each aircraft. Once the aircraft reached the set number of flying hours it required a phase inspection in order to reset the aircraft back to zero. The phase process was repeated on every aircraft in a fighter squadron's fleet every time it met the accumulated number of flying hours or interval between required phase inspections. An interesting side note was when the aircraft phase section personnel were not gainfully employed performing an aircraft phase inspection they often times were used by the fighter squadron to rebuild the cannibalization jet.[13]

The phase inspection process was and is an in-depth inspection of an aircraft's structural integrity, component function, and system reliability. The process was carefully choreographed and required close coordination between several agencies. The concept is not unlike a Nascar pit crew. But instead of 14-16 seconds of speed, precision, and coordination, the aircraft phase process and critical path management involved five days of the same kind of coordination. For simplicity sake, and for a basic understanding of an aircraft phase, I described the conduct of an aircraft phase inspection the following five major steps:

1. De-paneling to gain access to the required system components

2. Look phase – this involved the removal of system components and inspection of the component itself as well as the area in which the component was housed to check for cracks, discrepancies and integrity.

3. Fix phase – once the look phase was complete, all discrepancies discovered by the inspection team were repaired prior to reinstallation of system components.

4. Operational checks – once all components were reinstalled the systems were checked for proper operation/function. Any discrepancies discovered here were repaired as needed.

5. Re-paneling – the last portion of the phase involved the re-paneling of the aircraft and a quick aircraft wash prior to returning the jet to the flightline.

In actuality the process encompasses every system on the aircraft from weapons delivery and avionics to the fuel system and engines. Each system had a specific set of inspection cards with inspection requirements needed for completion of that system's portion of the inspection. Once all of the system card decks were completed the aircraft was operationally checked, re-paneled and returned to the flightline. It should be noted here however that the phase inspection also required the assistance of personnel from avionics, weapons, structural repair, egress, fuels, engines and other maintenance specialties that were not assigned to the phase section itself. Some of those agencies were organized under different sections within the fighter squadron while others were from different squadrons altogether. Though the process was little changed, the organization of the Phase Inspection Section changed significantly when the Air Force reorganized under the Combat Wing Organization Model in 2002.

Phase Inspection Under the Combat Wing Organization

As with the cannibalization process, the actual phase inspection process did not change with the AFs reorganization. However, the organizational structure did change rather dramatically. When the AF reorganized under the CWO in 2002, it did so to ensure that pilots were able to concentrate on the rigors and demands of flying while maintainers were able to concentrate on the long-term health of the aircraft fleet. As noted earlier the CWO pulled all maintainers out of the fighter squadrons and placed them under the Maintenance Group. This also allowed the AF to reevaluate the phase process and choose the right agency in which to place the phase personnel. Ultimately it was decided that the phase personnel would be assigned to the Equipment Maintenance Squadron and not the newly established AMXS. This streamlined the process and helped to create a better, more consistent product. It allowed the AMXS to concentrate on the critical tasks involved in flying and fixing jets without having to worry about conducting a labor intensive, in-depth inspection of an aircraft. It also allowed the Equipment Maintenance Squadron and its personnel to concentrate on the inspection itself and in turn the health of the aircraft and the fleet as a whole. Additionally, EMS was already an agency more closely tied to long-term fleet health processes than was the AMXS and far less reactive to the dynamics of daily flying operations. The changes just made sense, even though they were not a cure all.

One critical area that was not fixed was the problem of manning. Even though the agency responsible for managing the phase changed, the personnel needed to accomplish the phase did not. Several maintenance units were still required to provide system specialists to the phase inspection process at specific times. The AMUs still needed to provide weapons, avionics, engines and electrical/environmental specialists to the phase docks. The Component Maintenance Squadron also had Egress and Fuels System Specialists that needed to perform inspections on the aircraft. Because each of these agencies had their own competing demands and daily mission requirements there were often delays in providing the needed specialist support to EMS. This in turn delayed the completion of the aircraft phase inspection.

Phase and Cannibalization Processes at Hill Air Force Base

On 5 August 2002, the 388 FW took the changes made with the CWO one step further. Instead of leaving the ownership and responsibility for managing the three cannibalization aircraft with the AMUs in the AMXS, the 388 FW created two wing cann jets and aligned them with the phase aircraft under the maintenance flight. They also reduced the number of aircraft entering phase at any one time from three to two. There were several manpower changes that resulted from these two changes. An organizational chart of the 388 FW depicting these changes is located at Appendix A.

In essence, what the 388 FW did was take third phase dock's personnel and converted them to cannibalization dock personnel. Additionally, a small contingent of maintenance specialists (21 total personnel) from the avionics, weapons, engines, and electrical/environmental career fields were removed from the AMUs and reassigned to the Phase and cannibalization dock. These specialist technicians were dual-hatted and performed all phase inspection and cannibalization functions for the 388 FW. The decision was made not to assign any Fuels or Egress personnel from the CMS because it would be an inefficient use of manpower.

The process for the cannibalization of aircraft parts and the management of the aircraft changed significantly. When the AMU needed a part for an aircraft that was unavailable in the supply system, they called the production supervisor of their AMU and asked for authorization to remove the part from one of the cannibalization jet(s). Upon receiving verbal confirmation, the technician would then begin removing the bad part from the affected aircraft. Meanwhile, the production supervisor from the AMU would radio the phase and cannibalization dock to request the removal of the needed part from one of the wing cann jets. When the technician on the affected aircraft completed the removal of the bad part and completed the required paperwork to order a new one (via an AF Form 2005) they would drive to the phase and cannibalization dock to exchange them for the good part.

When it came time to rebuild one of the cannibalization aircraft, in order to avoid hangar queen status, the AMU providing the next aircraft would fly the jet to reset its last date flown and maximize the time it was able to be used as a cannibalization jet before nearing the hangar queen status. The aircraft was then configured for cannibalization status (i.e. all externally mounted pylons, munitions and fuel tanks removed) and then towed to the phase and cannibalization dock. Cann dock personnel would then begin rebuilding the aircraft being output. While this rebuild was ongoing these same personnel would still support cannibalization in direct support of daily flying operations as well as any phase inspection requirements.

The phase inspection process did not change, but phase aircraft management did. The shift from three to two docks required tighter control and more coordination among the three AMUs to avoid gaps in the phase flow. To accomplish this, the Maintenance

Group created and maintained a rotational schedule for cannibalization and phase aircraft input schedules. The requirement to provide a cann jet rotated through each of the AMUs. A new cann jet was input and an old one output from the cann dock every two weeks. Phase inspection inputs were also rotated through each of the AMUs. Since there were only two phase inspection docks, an AMU was responsible to provide every third phase input. These aircraft were identified weeks/months in advance, by aircraft tail number, so each AMU could manage the accumulated flying hours accordingly to meet the schedule. Every effort was made to take into consideration the mission needs, deployment, exercise, and depot input schedules to avoid any one AMU having too many aircraft out of service at any one time. What this all boiled down to, on average, was each AMU would receive two phase aircraft inspections and provide one cannibalization aircraft per month to the cannibalization dock.

A significant addition to the phase and cannibalization requirements was the need to launch/recover each cann/phase jet upon output. Previously this had always been done by the owning AMU, even after the changeover to the CWO. But by making this change, the 388 FW created a "report card" for how well the phase and cannibalization personnel had performed their jobs. If the jet flew Code 1--all systems operational with no maintenance problems noted by the pilot--then they performed their jobs well and they had no further requirements for that aircraft. On the other hand if the jet flew Code 3--significant problems with one or multiple aircraft systems--then the personnel had not performed their jobs well. In that case, they had the responsibility of repairing the affected system(s) and launching/recovering the aircraft until it flew Code 1. This ensured the AMUs received a good product back from cann and phase by creating buy-in, pride and ownership of the aircraft and the process by phase and cann personnel. Ultimately, the consolidation of phase and cann aircraft/personnel solved the following problems:

1. Better, more consistent product resulting from the modified processes and organizational structure of the phase and cannibalization sections. The same group of personnel looked

2. Better cann management – the AMUs were happy to get rid of the difficulties associated with managing the cannibalization aircraft. And the placement of the cannibalization jets under the Maintenance Flight significantly reduced documentation problems and the problems encountered during aircraft rebuilds.

3. More efficiently utilized maintenance specialists by making them dual hatted with responsibility for both Phase and Cannibalization processes

4. Input/output schedules managed by the calendar and are based on process requirements not on the competing needs of the daily flying schedule and AMU maintainer workload. The process and the health of the fleet is what is most important.

5. Reduced the number of aircraft down for phase and cannibalization from six to four aircraft

6. Implemented process where Phase and cannibalization personnel owned the aircraft till it flew a Code 1 sortie out of phase and cannibalization. This gave the Phase and cannibalization personnel process ownership and buy-in while also alleviating AMU personnel complaints that they would not receive a good product back from phase and cannibalization

7. The Critical Path of the aircraft Phase and cannibalization processes were interrupted far less often because the prioritization of workload for the two phase aircraft and the two cannibalization aircraft rests with the leadership of one unit, the Maintenance Flight.

Now that there is a firm understanding of the organizational changes within the Air Force over the past fifteen years and a working knowledge of how the 388 FWs aircraft phase and cannibalization management procedures/organizational structure differ from the rest of the F-16 fighter wings within Air Combat Command the researcher will move on to the review of relevant literature in chapter 2.

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[1]Tillie Fowler, “Fund Major Military Overhauls Now” [article on-line] available from http://www.rollcall.com/pages/pb/00/05/pb01g.html; Internet; accessed 23 June 2002.

[2]Ibid., 3.

[3]William S. Cohen, “Annual Report to the President and the Congress” (Washington, D.C.: Office of the Secretary of Defense, 1998).

[4]William S. Cohen, “Annual Report to the President and the Congress.” (Washington D.C.: Office of the Secretary of Defense, 1999).

[5]Ibid., 211.

[6]Ibid.

[7]Soldiers for the Truth: “All Too Often the Armed Forces Must Borrow Parts from One Airplane to Fix Another” [web site]; available from http://www.sftt.org/ article03122002a.html; Internet; accessed on 23 June 2002.

[8]Ibid., 1

[9]Jason Morrow, “America’s Military Badly Needs an Upgrade” [article on line]; available from http://www.nationalcenter.org/NPA251.html; Internet; accessed 23 June 2002.

[10]Department of the Army, Army Field Manual 7-100.2, *Opposing Force Doctrinal Framework and Strategy* (Washington, DC: Department of the Army), 2003.

[11]C. Todd Lopez, "Smart Operations 21 Office Formed at Pentagon" [article on line]; available from http://www.af.mil/news/story.asp?id=123020236; Internet; accessed on 15 Apr 2007.

[12]Aircraft that do not fly for significant periods of time have a tendency to develop nagging maintenance problems from not having their aircraft systems run/operating. Fluid leaks, Environmental Control System and Avionics System problems are among the more common. The longer an aircraft sits, (and in the case of cannibalization aircraft the more parts removed/reinstalled) the more difficult it is to return it to mission capable status. This is the reason that 'Hangar Queens' are managed aggressively at all levels.

[13]There were times when the fighter squadron's fleet may not have accumulated enough flying hours on a particular aircraft in order to conduct an aircraft phase inspection. This often was due to weather attrition, holidays, exercises or maintenance problems that caused an aircraft to miss one or several scheduled sorties. When this occurred there would be 'gaps' in the phase inspection process resulting in lost production time for the phase personnel. If one of these gaps coincided with the scheduled rebuilding of a cannibalization aircraft, the production supervisor would often times have the phase personnel conduct the rebuild due to their in-depth system knowledge and their skill in working as a closely integrated team. This also allowed the production supervisor to maximize the efficiency of his maintainers involved in activities directly associated with daily flying operations

CHAPTER 2

LITERATURE REVIEW

Researcher's Central Thesis

The review of relevant literature shows the impacts the declining military budgets have had on military readiness. Changes to the defense budget have been made and the "infusion" of dollars former Chief of Staff of the Air Force General Ryan called for in 1999 has led to near fully funded military budgets in FY01 and FY02.[1] However, the contracting and acquisitions processes take time to work and ultimately deliver. It is likely it will be quite some time before the lack of spare parts is mitigated. In the mean time, the military must continue to do what it can to incorporate alternative methods of doing business to overcome the supply shortage.

This study analyzed the impact that consolidating cannibalization aircraft and colocating them with the Equipment Maintenance Squadron's Phase Inspection Section will have on key maintenance indicators, most notably the mission capable rate. A significant increase in the mission capable rate may result from the direct benefits gained from the alternative method of consolidating F-16 cannibalization and phase aircraft in the same facility under the same management and maintenance personnel. The researcher hypothesizes this new cannibalization program will significantly increase the 388th Fighter Wing's mission-capable rate and will have positive effects on the other key maintenance indicators. The researcher considers a significant increase to be an overall rise in the mission capable rate of 1.7 percent or greater.

Air Force Instruction 21-101

The United States Air Force Instruction 21-101, *Aerospace Maintenance Management*, dictates the guidelines and governs all actions pertaining to the management of aircraft and aerospace equipment in USAF inventory.[2] Within this document is a section for special programs including the cannibalization program. Specifically, AFI 21-101 designates the Maintenance Group Commander (MXG/CC) as having sole responsibility for the proper management of the cannibalization program. The MXG/CC may designate Cannibalization (CANN) Authorities (Officers or Senior Non-Commissioned Officers) to authorize cannibalization actions.[3]

Cannibalization actions, as defined by AFI 21-101, are "the authorized removal of a specific assembly, subassembly, or part from one weapon system, system, support system, or equipment end item for installation on another end item to satisfy an existing supply requisition and to meet priority mission requirements with an obligation to replace the removed item."[4] Simply stated, if there are two nonmission capable aircraft and no serviceable supply part on-hand to repair the aircraft, a serviceable part may be removed from one to fix the other. This ensures maximum daily aircraft availability to accomplish the mission. After a large number of cannibalized parts are consolidated onto one aircraft that aircraft is then known as a cannibalization aircraft or Cann Bird.

Air Force Instruction 21-101 goes on to state that authorization to cannibalize an aircraft part may only come after careful consideration of both the advantages and disadvantages of the cannibalization action. On the one hand a cannibalization action will allow a nonmission capable aircraft to be repaired and quickly returned to service. On the other hand the cannibalization action increases the workload on the maintenance technicians and runs the risk of putting additional wear and tear on serviceable parts or rendering them unserviceable. Each cannibalization action must be considered with this in mind.

In addition to the direct advantages/disadvantages, careful consideration of the unintended consequences of actions must be kept in mind. Cannibalizing aircraft parts can impact the inventory and supply system by providing potentially false metrics data to decision-makers. When an aircraft is nonmission capable due to the non-availability of a supply part in the on-base inventory, the time it takes for the part to be ordered, requisitioned and shipped to the unit requesting the part is tracked as not mission capable for supply (NMCS) time. This metric (one of the many maintenance metrics tracked at Air Combat Command at Langley AFB, Virginia) is one of the key metrics utilized when justifying supply parts budgets to Senior AF leadership and in turn to Congress. When several needed supply parts are removed from the cannibalization jet, there is only one aircraft that shows any NMCS time instead of the several aircraft that should show NMCS time. This demonstrates the Catch-22 of cannibalizing aircraft parts. By solving one problem, the AF is creating another. While cannibalizing aircraft parts is beneficial to mission completion in the near term, it is detrimental to the long term data used to track the health of the supply system and justify spare parts expenditures.

Other factors such as the length of time and difficulty involved in removing the part, the potential for damage to the serviceable part, and the length of time estimated before a serviceable part is to arrive through supply channels must be considered before a cannibalization action is authorized. Group Commanders have the overall responsibility of ensuring cannibalizations are held to an absolute minimum and cannibalization aircraft are properly managed to ensure their prompt return to full mission capable status.[5]

A Decade of Reduced Military Budgets

Since the end of the Gulf War and the Cold War the military budget has been reduced drastically. The "Peace Dividend" resulting from the US victories in the Gulf War and the Cold War and the lack of a foreseeable peer competitor made it difficult for the US military to justify to Congress the need for large military budgets to fund cutting edge technology for the services. After all if there is no peer competitor to the United States military, then why fund costly programs for new weapons systems that are not needed? For this reason the demands in the 1990s shifted and allowed the US government to focus on more domestic issues throughout the rest of the 1990s. This did not, however, change the demands placed on the military. In fact, it was quite the contrary.

Throughout the 1990s, the Clinton-Gore administration seemed to use the US military as the "world policeman" for humanitarian and peacekeeping operations that erupted in many of the world hot spots. The result was the Clinton-Gore administration significantly overtasking a military that was neither funded nor designed to operate in that manner. Military deployments during the Clinton-Gore administration increased more than 450 percent compared to the previous decade as the number of deployments increased from 30 between 1983 and 1993 to 136 from 1993 to 2000.[6] Simultaneously, the defense budget was underfunded over $300 billion in cumulative dollars from 1993 to 2000.[7] The defense budget in Fiscal Year 2000 was less than three percent of the gross domestic product, the lowest level since the attack on Pearl Harbor.[8]

The Clinton-Gore administration's insistence on reduced military budgets also impacted the procurement of new equipment. According to James Schlesinger, former Defense Secretary under Richard M. Nixon, the US spends $40 billion a year on procurement but has a cost of $100 billion per year on depreciation of current equipment leaving a shortfall of $60 billion just to maintain the current state of readiness.[9] This statistic demonstrates the slippery slope the Air Force is on. The Defense Department needs to increase the procurement budget by $60 billion just to keep the status quo. If any level of modernization is to take place, an increase greater than $60 billion is needed.

The Readiness Crisis in the Air Force

There is no doubt the United States Air Force and the military are in a readiness state of crisis. Readiness rates have declined nearly 23 percent since 1996.[10] This steady decline has forced Senior Air Force leaders to strongly state requirements and needs to Congress on Capitol Hill. As early as 1998 the United States Air Force identified the impact the budget cuts were having on its capability to perform its mission. Gen Richard Hawley, the former Commander of Air Combat Command, testified before the Congressional Armed Services Committee that the trends in key maintenance indicators were nearing those of the Post-Vietnam era "hollow force". In fact, the mission capable rate, nonmission capable for maintenance rate, nonmission capable for supply rate, the cannibalization rate, and the retention rate of personnel in the Air Force were all on negative trends, particularly in 1997 and 1998.[11]

During his testimony to Congress in March 1998, Lieutenant General William P. Hallin, Deputy Chief of Staff for Installation and Logistics, stated that from the peak of readiness during the Gulf War in 1990 and 1991 when the mission capable rate for all Air

Force aircraft was 83.4 percent, USAF has been on a significant and steady decline reaching only 74.6 percent in 1998.[12] General Hallin also spoke of retention rates and the effect the lack of military funding was having on retaining trained and qualified technicians in the service. Most notable in his testimony, however, was the rise in total nonmission capable rate for supply (TNMCS), which rose from 8.6 percent in FY91 to 14.1 percent in FY98.[13]

Throughout the 1990s, several Air Force leaders spoke of the potential effects the diminishing military budgets might have on readiness. In the late 1990s these same leaders described the affects the cutbacks were having on readiness. In 1999, the former Chief of Staff of the Air Force, Gen Michael E. Ryan, along with the other Service Chiefs and the Chairman of the Joint Chiefs of Staff, testified before Congress about the decline in military readiness. General Ryan called for $30 billion more in funding for readiness over the next six years to stop the decline and reverse the trend. “We need a sustained infusion of dollars for the foreseeable future.”[14]

USAF Posture Statement

The United States Air Force Posture Statement is a document co-authored and approved by the Secretary of the Air Force (SECAF) and the Air Force Chief of Staff (CSAF). This document summarizes the Air Force’s accomplishments over the past year and shows where the SECAF and CSAF think the USAF will go in the future. Two of the largest discussion topics in this document from 2001 are readiness and modernization. Both topics generated some very compelling statistics. For instance, the readiness rate for the Air Force has dropped twenty-three percentage points from ninety-one percent in 1996 to sixty-eight percent in 2001.[15] Additionally, while the number of flying hours flown by USAF pilots for training has remained relatively constant during this same time period, the cost to produce those flying hours has increased by forty-five percent.[16]

An equally compelling statistic is the increasing age of the aircraft in the USAF inventory. The average age of the aircraft flown by USAF is almost twenty-two years and rising and is expected to reach nearly thirty years by 2020. As General Ryan stated, “even if we were to execute every modernization program currently on the books, which amounts to procuring 100 aircraft per year, our aircraft age continues to rise.” General Ryan goes on to show that to mitigate the rise in the average age of the fleet, the USAF would have to procure nearly 150 aircraft per year and to actually reduce it would require 170 aircraft per year.[17]

Former Secretary of the Air Force, The Honorable James Roche and General Michael Ryan demonstrated how the Air Force has done its job to reduce costs and do all it can to make the Air Force as efficient an agency as possible. They have continued to save money through product improvements, implementation of industry best practices, outsourcing and privatizing of certain base functions, and base realignments and closures to save on infrastructure. In fact, the Air Force has saved more than $30 billion in the past decade.[18]

General Accounting Office Audit

Congressman Christopher Shays, Republican from Connecticut, and Chairman for the Subcommittee on National Security, Veterans Affairs, and International Relations, Committee on Government Reform, House of Representatives, led a year 2001 General Accounting Office Audit on military aircraft and cannibalizations. The audit discovered several startling facts about the military’s practice of cannibalization.

The audit first discussed the military's reasons for cannibalization. The audit stated the pressure to meet readiness and operational needs and the lack of spare parts in the supply system were the main reasons the services cannibalized parts from one aircraft or piece of equipment to fix another.[19] While these are very good reasons, the impact it has on the health of the aircraft fleet and the workload of aircraft maintainers is very detrimental.

Congressman Shays also discussed the adverse impact cannibalizations have on the military. First, cannibalization increases the costs to maintain equipment since it doubles the amount of time required to fix an aircraft as each removal and installation of a part happens twice instead of just once. Second, cannibalization may take the cannibalization aircraft out of service for long periods of time. Third, cannibalization has been shown to cause additional mechanical problems on the aircraft as the constant removal and installation of parts causes unnecessary wear and tear on the part itself, other aircraft systems, or the aircraft as a whole. Lastly, the increased workload, the frustration over the lack of spare parts, and the long hours worked by maintainers throughout the services has had negative effects on the morale and retention rates.[20] This was further supported by the Congressional testimony of all the Service Chiefs in 1999 mentioned above.

The audit team found the services do not do a very good job of reporting, tracking or managing cannibalizations. In many cases they under report cannibalization actions and have done a very poor job of strategizing to reduce cannibalization actions or the associated man-hours. In fiscal years 1996-2000 the Air Force averaged about 75,000 cannibalizations a year with sixty percent of them coming from only four aircraft, the B-

1B, F-16C, F-15C and the F-15E which were in high demand in Operations Northern Watch and Southern Watch during this period.[21] During this same time, a majority of maintenance technicians reported working over fifty hours a week with many reporting working in excess of seventy hours per week.[22]

The recommendations of the General Accounting Office audit included "establishing standardized, comprehensive, and reliable cannibalization data collection procedures and developing strategies to reduce the amount of time spent on cannibalizations."[23] By doing this, the hope is the services will be able to track the realistic number of cannibalization actions performed each year, discover the root causes of these actions and develop strategies to reduce them. This will slowly improve the overall readiness of the US military and buy time for the increase in the defense budget to affect the maintenance, modernization and procurement of a newer, healthier fleet of aircraft.

388 FW Hill AFB Cannibalization Program (Prior to 5 August 2005)

The 388th Fighter Wing Instruction 21-21 is the instruction governing the use of cannibalization practices within the 388th Fighter Wing. The current cannibalization program at Hill AFB involves three aircraft used as forward supply points for critical parts not available in the supply system. The wing's three cannibalization aircraft are, in reality, one cannibalization aircraft from each flying squadron in the wing, used to assist the repair of their squadron's fleet of aircraft. When it is determined that a part is needed from the cannibalization aircraft, the squadron requiring the part places an emergency requisition, called a MICAP (a part needed to make an aircraft fully mission capable), for the required part in the supply system. The squadron maintenance technicians then remove the serviceable part from the cannibalization aircraft and install it into the aircraft needing the part. When a part is needed for an aircraft and that part has already been removed from the squadron's own cannibalization aircraft for another repair, the squadron will seek the part from one of the other squadron's cannibalization aircraft. This process maximizes aircraft availability to each squadron for its daily flying schedule. What this process does not do, however, is provide maximum aircraft availability to the wing as a whole. This last statement is what drove the Wing Commander of the 388th Fighter Wing to request changes to the 388th Fighter Wing's Cannibalization Program.

Wing Commander Requested Changes to Cannibalization Program

Dissatisfaction with the readiness rate of the 388th Fighter Wing and a desire to maximize aircraft availability for the daily flying mission drove Colonel Stephen Hoog, former Wing Commander for the 388th Fighter Wing, to request changes in the way the aircraft fleet was managed. One of his requests was an improvement in the management of the cannibalization aircraft. His desire was to reduce the cannibalization aircraft in the wing from three individual squadron cannibalization aircraft to two wing cannibalization aircraft to be used by all three fighter squadrons. These wing cannibalization aircraft would be controlled and managed by a centralized wing team ensuring proper documentation of aircraft part removals and tracking of the status of the needed parts in the supply system.

The changes he requested provided the wing several advantages. First, it improved the management and rebuilding processes of the cannibalization aircraft. Second, it reduced by thirty-three percent the number of aircraft, per year, used as cannibalization aircraft, minimizing unnecessary wear and tear on other aircraft and their systems. Third, it made additional aircraft available to the wing for flying training purposes allowing the fighter squadrons to maximize flying training. Next, it increased the speed in obtaining the supply part allowing maintenance technicians to get to the job of fixing their aircraft quicker. Lastly, it served to increase the mission capable rate and wing readiness rate.

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[1]Air Force News. “Joint Chiefs Request More Funds for Readiness” [article on line] available from http://www.af.mil/news/Jan1999/n19990111_990027.html; Internet; Accessed on 23 June 2002.

[2]U.S. Air Force. Air Force Instruction 21-101, *Aerospace Equipment Maintenance Management*, (Washington, DC: Department of the Air Force), 2002.

[3]Ibid.

[4]Ibid.

[5]Ibid.

[6]Fowler, “Fund Major Military Overhauls Now”, 2.

[7]Ibid., 1

[8]Ibid., 1

[9]Morrow, “America’s Military Badly Needs and Upgrade”, 2

[10]James G. Roche and Michael E. Ryan, *United States Air Force Posture Statement; A*vailable from http://www.posturestatement.hq.af.mil/; Internet; accessed 23 June 2002.

[11]Richard G. Hawley, “COMACC Statement to House National Security Subcommittees on Military Readiness, Military Personnel and Military Installations” [article on line] available from http://www2.acc.af.mil/library/speeches/cc/092598.html; Internet, Accessed 23 June 2002.

[12]William P. Hallin, “Statement to House National Security Subcommittee on Military Readiness” [article on line] available from http://www.house.gov/hasc/testimony 105thcongress/3-11-98hallin.htm; Internet; Accessed 8 July 2002.

[13]Ibid., 8.

[14]Air Force News, “Joint Chiefs Request More Funds for Readiness”, 4.

[15]James G. Roche and Michael E. Ryan, *USAF Posture Statement*, 1.

[16]Ibid., 1.

[17]Ibid., 2.

[18]Ibid., 3.

[19]Christopher Shays, “General Accounting Office Audit on Military Aircraft. Services Need Strategies to Reduce Cannibalizations” [article on line] available from http://www.yahoo.com; Internet; Accessed 23 June 2002.

[20]Ibid., 16.

[21]Ibid., 8.

[22]Ibid., 2.

[23]Ibid., 36.

CHAPTER 3

RESEARCH METHODOLOGY

Explanation of Research Comparison Phases

As identified in Chapter 1, this thesis focused on the effects of consolidating F-16 phase and cannibalization aircraft on key maintenance indicators. The answer to this question came in three phases. Phase I involved a comprehensive review and quantitative analysis of the key maintenance metrics and statistical data of the 388 FW over the last six years, from FY2001 through FY2006. The researcher's focus here was to ensure a measurable difference in pre-program implementation and post-program implementation existed within the 388 FWs key maintenance metrics. Phase II involved a comprehensive review and quantitative analysis of the key maintenance metrics and statistical data of the 388 FW compared to the rest of the Air Combat Command F-16 Fleet over the same period. Phase III involved the compilation of my assessments and judgment of the Phase II in a table to discern the impact of the consolidated phase and cannibalization program.

Phase I: Comparison of 388 FW Pre- and Post-Program Maintenance Metrics

In accordance with AF policy, the 388 FW is required to send cumulative monthly and yearly maintenance metrics data to the Logistics Staff (A4 Staff) at the Air Combat Command (ACC) Headquarters located at Langley AFB, Virginia. To do this, the 388 FW (as well as every other aircraft wing in the AF) inputs and maintains statistical data for every single maintenance/flight related action that occurs on each of the aircraft in the wing in a huge database called the Core Automated Maintenance System (CAMS). The metrics contained in this database are compiled at the end of each month and screened for accuracy. Prior to submission of the data to ACC A4, the data is sorted into the categories required by the A4 staff and screened one more time for accuracy. The monthly and yearly statistical data for more than 40 categories of maintenance metrics are provided to the analysis section of the ACC A4 staff for every aircraft owned by the 388 FW. (This process is also done by every other aircraft wing in the AF). These maintenance indicators/metrics include:

0. Sorties scheduled, programmed and actually flown
1. Flying hours scheduled, programmed and actually flown
2. Aircraft possessed hours
3. ***Mission capable, nonmission capable for maintenance, nonmission capable for supply and nonmission capable for both maintenance/supply hours and their corresponding rates
4. ***Partially mission capable, partially nonmission capable for maintenance, partially nonmission capable for supply and partially nonmission capable for both maintenance/supply hours and their corresponding rates
5. Chargeable and non-chargeable deviations to the printed flying schedule and the agency the deviation is attributed to
6. ***Flying Scheduling Effectiveness rate
7. ***Ground aborts, Air aborts and the corresponding abort rate
8. ***Aircraft breaks and the corresponding break rate
9. ***Aircraft breaks repaired in 4, 8, and 12 hours and their corresponding rates
10. ***Cannibalizations performed and the corresponding rate

11. ***The number of maintenance man-hours performed

12. ***The number of maintenance man-hours performed per flying hour

For the purposes of this study, the metrics highlighted with asterisks above are the metrics used in the comparison of the 388 FWs metrics for pre- and post-consolidated phase and cannibalization program implementation.

The Consolidated Phase and Cannibalization Program at Hill AFB, UT was implemented in August 2002, just over four years ago. For this reason, the researcher chose a six year period of review, two years before implementation and four years after implementation. The researcher had hoped to compare the data four years prior and four years after program implementation in order to provide an equal time period for an in-depth comparison. However, the 388 FW does not have data dating back prior to FY2001.

The researcher sought and received the raw cumulative monthly and yearly data from the 388 FWs Analysis Section for the last six fiscal years (FY2001-FY2006). The researcher then conducted a comprehensive review and quantitative analysis of the data for this time period. The raw data for all six fiscal years was placed into a Microsoft Excel spreadsheet. The researcher then utilized this raw data to create Microsoft Excel graphs for each of the nine maintenance metrics utilized in this study. These graphs were placed in Chapter 4 of this study and are identified as Figures 1-1 through 9-1. The researcher's focus here was to ensure a significant measurable difference existed between pre-program implementation and post-program implementation. Once established, the researcher moved on to Phase II of the study--comparing the 388 FWs results to those of other F-16 fighter wings in ACC.

Phase II: Comparison of 388 FW and ACC F-16 Maintenance Metrics

The Logistics Staff (A4 Staff) at the Air Combat Command Headquarters located at Langley AFB, Virginia tracks cumulative monthly and yearly data for all aircraft systems throughout the AF. As mentioned above, more than 40 categories of statistical data are provided on a monthly basis to the analysis section of the ACC A4 staff from all of the fighter, bomber, cargo and special mission wings throughout the AF. The metrics are tracked by aircraft type (i.e., F-16, C-5, or U-2, etc.) as well as by Squadron, Wing, Numbered Air Force, and Major Command.

The researcher sought and received the cumulative yearly data for all F-16 units in Air Combat Command from the ACC/A4 Analysis Section for the last ten fiscal years. A similar review/analysis to the one conducted in Phase I was accomplished for this ACC-wide F-16 data. The same time period, FY2001 through FY2006 was used for this analysis. The researcher then took the resulting data and compared it with the results of Phase I. To do this, the researcher manually input the raw data from ACC and from the 388 FW into a Microsoft Excel spreadsheet. The researcher had to convert the 388 FWs monthly data into cumulative yearly data similar to ACC. This Microsoft Excel Spreadsheet is located at Appendix B. Finally, the researcher created Microsoft Excel graphs with trend lines to compare ACCs F-16 metrics to those of the 388 FW. These graphs are located in Chapter 4, Phase II and are identified as Figures 1-2 through 9-2.

Phase III: Author’s Assessment of 388 FW vs. ACC Comparison

This phase of the assessment involved compiling the results of Phase II in a comparison table to allow me to make a final assessment of the consolidated phase/cann program’s impact on the key maintenance indicators. At the end of each of the nine paragraphs in Phase II of chapter 4, I made an assessment of which agency (388 FW or ACC) had the better performance in two categories--better overall metric and relative growth performance. The better overall metric assessment was based simply on the direct mathematical averages of each agency's metric during the evaluation period. The relative growth performance is simply a comparison of the trend lines of each agency.

The table contains the nine key maintenance metrics in rows. The overall metric and relative growth performance categories are contained in columns and are further broken down between the 388 FW and ACC. For each maintenance metric I indicated which agency had the better performance in overall metric and relative growth performance by placing a "+" in that column. If little or no difference existed, I indicated it with a (o) sign (see Table 2), and the results are addressed in both chapters 4 and 5.

CHAPTER 4

ANALYSIS

F-16 Aircraft Maintenance Metrics

As identified in Chapter 1, this thesis focuses on the effects of consolidating F-16 phase and cannibalization aircraft on key maintenance indicators. In Chapter 3 of this thesis, the researcher described the method by which he measured the effects. This chapter's focus is on the specific results of that research. The results were analyzed by the researcher in four phases. Phase I involved a comprehensive review and quantitative analysis of the key maintenance metrics and statistical data of the 388 FW over the last six years, from FY2001 through FY2006. The researcher's focus involved ensuring a measurable difference in pre-program implementation and post-program implementation existed within the 388 FWs key maintenance metrics. Phase II involved a comprehensive review and quantitative analysis of the key maintenance metrics and statistical data of the 388 FW compared to the rest of the Air Combat Command's F-16 Fleet over the last six years (FY2001 through FY2006). Phase III involved a comprehensive review and qualitative analysis of the results of the data comparison in Phase II with respect to variables and mitigating factors specific to certain F-16 units that must be factored in when comparing the statistical results of Phase II. To fully understand the results it is critical to have an understanding of both leading/lagging indicators and why an upward or downward trend in a specific metric is either good or bad.

Leading versus. Lagging Indicators

This section is designed to provide a working knowledge of maintenance metrics. This in turn will help to understand how maintenance metrics can be used to aid leaders, supervisors, and technicians in making critical decisions about performance, developing trends and overall health of an aircraft fleet. As defined in Air Force Instruction 21-101 *Aircraft and Equipment Maintenance Management,* maintenance metrics "provide a measurement of performance and capability."[1] They are a tool that maintenance managers and technicians can use to develop numerical pictures of trends and equipment status. From these numerical pictures, leaders/managers can draw solid conclusions about mission accomplishment, equipment performance and the positive/negative climate within their maintenance organization. This helps leaders to make decisions and take corrective actions to reverse negative performance or continue actions that foster positive performance. Used properly, maintenance metrics speak volumes about an organization's performance.

Critical to every maintenance leader is an understanding of the difference between a leading maintenance indicator/metric and a lagging indicator/metric. Therefore, it is equally important to have a similar understanding. A simple definition of a leading indicator is a performance metric that happens first. AFI 21-101 describes a leading indicator as "an indicator that shows a problem first and has a direct impact to maintenance's capability to provide resources to execute the mission."[2] In other words, a leading indicator is a number that measures a series of actions (i.e. the number of cannibalizations of parts or the number of times an aircraft or aircraft system breaks).

Taken in this context, a leading indicator is a measure of those actions that help drive or determine the result of the lagging indicators.

Lagging indicators, according to AFI 21-101, are performance metrics that "follow and show firmly established trends."[3] They can best be understood as the direct result of all the actions measured by leading indicators. Positive or negative trends in the lagging indicators are the direct result of positive or negative trends in the leading indicators. To illustrate this point look at the aircraft mission capable rate as an example. This lagging indicator is a measure of the percentage of time an aircraft is capable of performing its designed mission. This percentage drops every time an aircraft or one of its systems malfunctions. The number of times an aircraft or one of its systems breaks is called the Aircraft Break Rate (a leading indicator). One can see the Aircraft Break Rate has an impact on mission capable rate and helps to determine its outcome. In this same example, it is not only the number of times an aircraft is broken but also the duration of time a particular aircraft or aircraft system is broken that helps to determine mission capable rate. One of the metrics used to help measure this is the eight-hour fix rate. The eight-hour fix rate is a measure of the percentage of time a maintenance technician was able to repair a particular aircraft or system within an eight-hour period after initial malfunction. The higher the eight-hour fix rate, the more successful maintenance technicians are in repairing their broken aircraft and the less the impact on the mission capable rate.

It is important to note that no one single leading indicator is the sole determining factor of a lagging indicator. On the contrary, all of the leading indicators have an impact in determining more than one lagging indicator. Additionally, several of the leading indicators have an impact in determining all three of the lagging indicators. It is also important to note that a maintenance leader cannot improve a lagging indicator by focusing on the lagging indicator itself. In order to improve a lagging indicator, maintenance managers and leaders must concentrate instead on effectively improving the leading indicators to reverse a negative trend in their lagging indicators. Though there are a multitude of leading/lagging indicators measuring maintenance performance, for the purpose of this thesis, the researcher concentrated on the following six leading and three lagging indicators. The leading indicators in this thesis are:

1. Aircraft Break Rate
2. Eight-hour Fix Rate
3. Abort Rate
4. Flying Scheduling Effectiveness Rate
5. Cannibalization Rate
6. Repeat/Recur Rate

The lagging indicators in this thesis are:

7. Mission Capable Rate
8. Nonmission Capable for Maintenance Rate
9. Nonmission Capable for Supply Rate

Understanding leading and lagging indicators is critical to understanding the information contained in this research product. Learning why an upward or downward trend in some maintenance indicators is good and in others bad is also very important and is the next topic of discussion.

Maintenance Metrics: Why Up or Down is Good or Bad

In a production oriented business and industry an upward trend in measured performance could be good or bad. It all depends on the metric being measured and what the metric is designed to tell the manager analyzing the metric. For instance an upward trend in safety mishaps or production discrepancies on an assembly line is bad. At the same time, a downward trend in the same categories would be good.

With regard to upward and downward trends in metrics, the aircraft maintenance business is no different from industry. Depending on the metric measured, an upward or downward trend can be good or bad. In the study conducted by the researcher there are six leading indicators and three lagging indicators. The leading indicators where a downward trend is good are:

Aircraft Break Rate. Down is good because it indicates aircraft and aircraft systems broke less often. If the trend is downward, one would likely see a corresponding rise in maintenance capable rate and a drop in nonmission capable rate due to maintenance. The opposite would be true if the trend were upward.

Abort Rate. Down is good because it indicates fewer missions were aborted due to maintenance discrepancies. With a drop in the abort rate, one would also likely see a corresponding rise in maintenance capable rate and drop in nonmission capable rate due to maintenance. With an upward trend one would expect to see the opposite occur.

Cannibalization Rate. Down is good here because it indicates that parts were cannibalized from other aircraft less often. With a downward trend in cannibalization rate, one would likely see a rise in mission capable rate and drops in both the nonmission capable rate due to maintenance and supply. The opposite would occur with a rise in cannibalization rate.

Repeat and Recur Rate. Down is good because it indicates that when a maintenance discrepancy was repaired the problem did not persist (i.e. repeat during the next sortie or recur within three sorties after repair). While a downward trend in this metric is a good thing, it does not necessarily equate to a rise in maintenance capable rate or drop in nonmission capable rate due to maintenance.

The leading indicators where an upward trend is good are the Eight-hour Fix Rate and the Flying Scheduling Effectiveness Rate.

Eight-hour Fix Rate. The reason an upward trend is good is it indicates maintenance personnel were able to repair aircraft and system discrepancies in less than eight hours, thus minimizing aircraft downtime and in turn improving the mission capable rate.

Flying Scheduling Effectiveness Rate. The reason an upward trend is good is it indicates that the aircraft designated to fly a particular mission were able to do so with greater success. It means the printed flying schedule is being met with fewer and fewer deviations. An example of a deviation would be an aircraft that ground aborts due to a maintenance malfunction or a sortie that is cancelled due to the lack of availability of an aircraft to fly that sortie. The higher the flying scheduling effectiveness rate the fewer the deviations from the printed flying schedule.

The lagging indicator where an upward trend is good is the mission capable rate.

Mission Capable Rate. An upward trend in this metric indicates a maintenance organization that is improving the 'health' of its aircraft fleet. The higher the mission capable rate the more often the aircraft are mission capable indicating a healthier fleet. The lagging indicators where an upward trend is bad are the Nonmission Capable Rate for Maintenance and the Nonmission Capable Rate for Supply.

Nonmission Capable for Maintenance Rate. The reason an upward trend in nonmission capable rate for maintenance is bad is it is indicative of an aircraft fleet that is less capable of meeting its mission. With an upward trend in this lagging indicator, one would expect to see a rise in the ground abort rate, the aircraft break rate, and perhaps the cannibalization and repeat/recur rates. One would also expect to see a drop in the flying scheduling effectiveness and eight-hour fix rates.

Nonmission Capable for Supply Rate. The reason an upward trend in nonmission capable rate for supply is bad is it is indicative of a supply system that is not fulfilling the needs of the maintenance organization. This means that a maintenance organization has the manpower to fix the aircraft but the supply system is unable to provide the part needed to complete the repair. With an upward trend in this lagging indicator, one would expect to see a corresponding rise in the cannibalization rate and a drop in the eight-hour fix rate as well as potential rises in the ground abort and aircraft break rates.

Phase I: Measurable Effect on 388 FW Maintenance Metrics

As identified in the beginning of this chapter, the purpose of the Phase I analysis was to ensure a measurable difference in the maintenance metrics of the 388 FW after the Phase and cannibalization program in August 2002. The results have been placed in the nine charts (Figure 1 through Figure 9). To help in understanding the charts showing these results/metrics, the researcher has placed the appropriate “Up is Good” or a “Down is Good” arrow in the lower right hand corner of the chart.

<u>388 FW Six-Year Aircraft Break Rate Trend</u>

This maintenance metric is used to measure the percentage of time a maintenance units aircraft return from their sorties in a “Code-3” condition (i.e. with a malfunctioning system).[4] The formula used to calculate the aircraft break rate is the number of sorties landing Code-3 in a month divided by the total number of sorties flown in that same month times 100 or:

Break Rate = (# of “Code 3” Sorties/Total # of Sorties) x one hundred[5]

Referring to the 388 FWs six year trend in Figure 1 there is an upward trend line. This indicates a negative performance trend. The average break rate for the 388 FW during this period was 10.4 percent with the best month in June 2001 when the break rate was only 6.5 percent and the worst month in October 2005 when the break rate reached a high of 18.3 percent.[6]

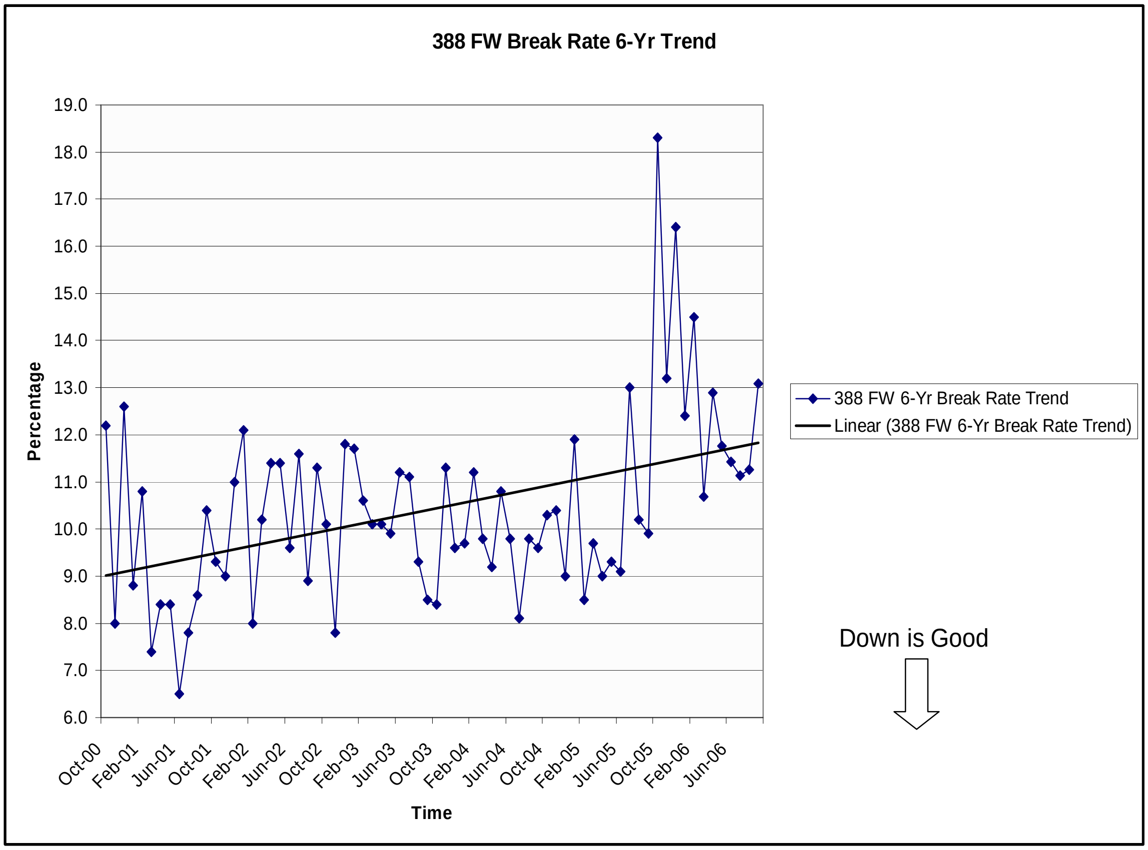


Figure 1. 388 FW Six-Year Break Rate Trend
Source: Data from 388 FW Analysis Section (Hill Air Force Base, Utah) 9302 Monthly Reports dated October 2000 through September 2006

388 FW Six-Year Eight-Hour Fix Rate Trend

The eight-hour fix rate helps a maintenance leader assess the repair capability of a maintenance unit. According to AFI 21-101 this rate measures "the percentage of time an aircraft with a landing status code of 3 is returned to a flyable status in a certain amount of time or clock hours."[7] The formula used to calculate the eight-hour fix rate is the number of Code-3 breaks fixed within eight hours divided by the total number of Code-3 breaks times 100 or:

Fix Rate = (# of Code-3 breaks fixed in eight hours/Total # of Code-3 Breaks) x one hundred[8]

Referring to the 388 FWs six-year trend in Figure 2 there is an upward trend line. This indicates a positive performance trend. The average eight-hour fix rate for the 388 FW during this period was 72.68 percent with the best month in March 2005 when the fix rate was 86.9 percent and the worst month in February 2003 when the fix rate reached only 58.7 percent.9

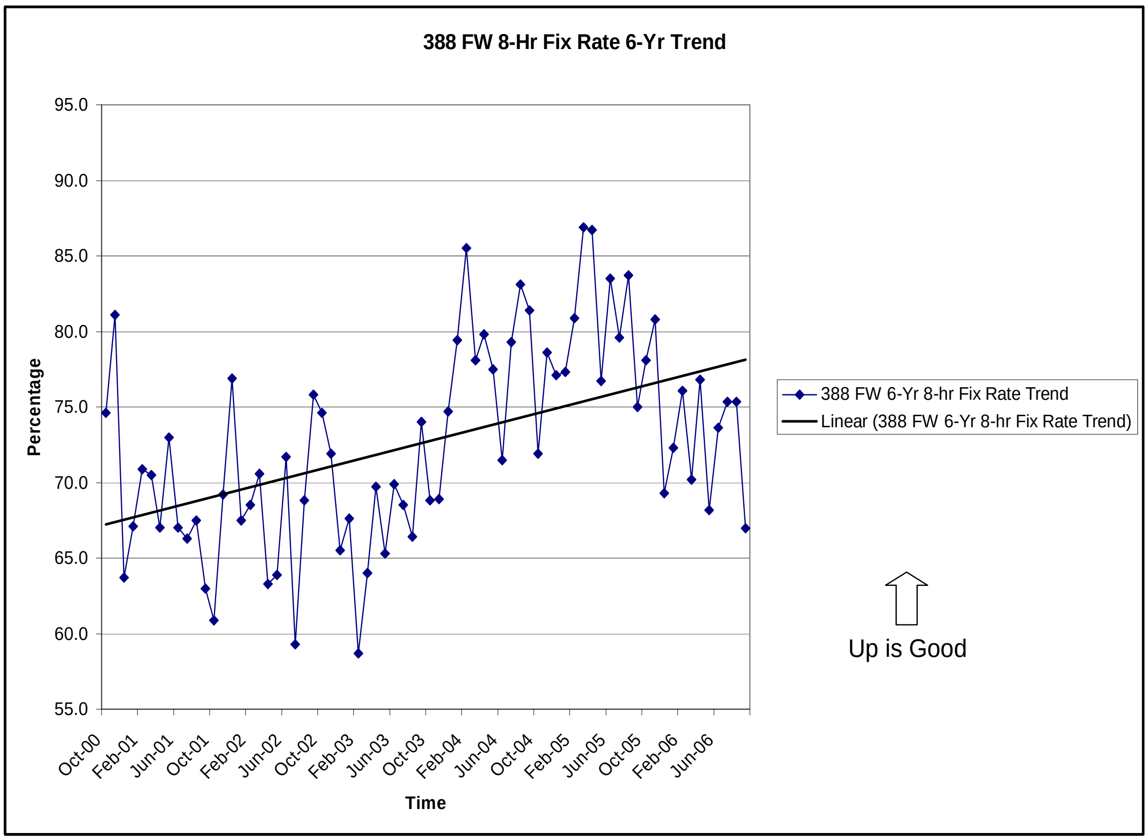


Figure 2. 388 FW Six-Year Eight-Hour Fix Rate Trend
Source: Data from 388 FW Analysis Section (Hill Air Force Base, Utah) 9302 Monthly Reports dated October 2000 through September 2006

388 FW Six-Year Abort Rate Trend

The abort rate is a critical maintenance metric because it assesses a unit's capability to successfully launch and complete its missions. It is used by maintenance supervisors to measure the percentage of time an aircraft aborts a mission or sortie. It is also an indicator of a unit's "aircraft reliability and quality of maintenance performed."[10] The formula used to calculate the abort rate is the sum of the number of air aborts (missions aborted after take-off) and ground aborts (missions aborted before take-off) divided by the sum of the number of sorties flown and ground aborts times 100 or:

Abort Rate = ((Air Aborts + Ground Aborts)/ (Total Sorties + Ground Aborts)) x one hundred[11]

Referring to the 388 FWs six-year trend in Figure 3 there is a slight upward trend line. This indicates a slightly negative performance trend. The average abort rate for the 388 FW during this period was 6.35 percent with the best month in June 2001 when the rate was just 3.8 percent and the worst month in December 2005 when the rate skyrocketed to 12.3 percent.[12]

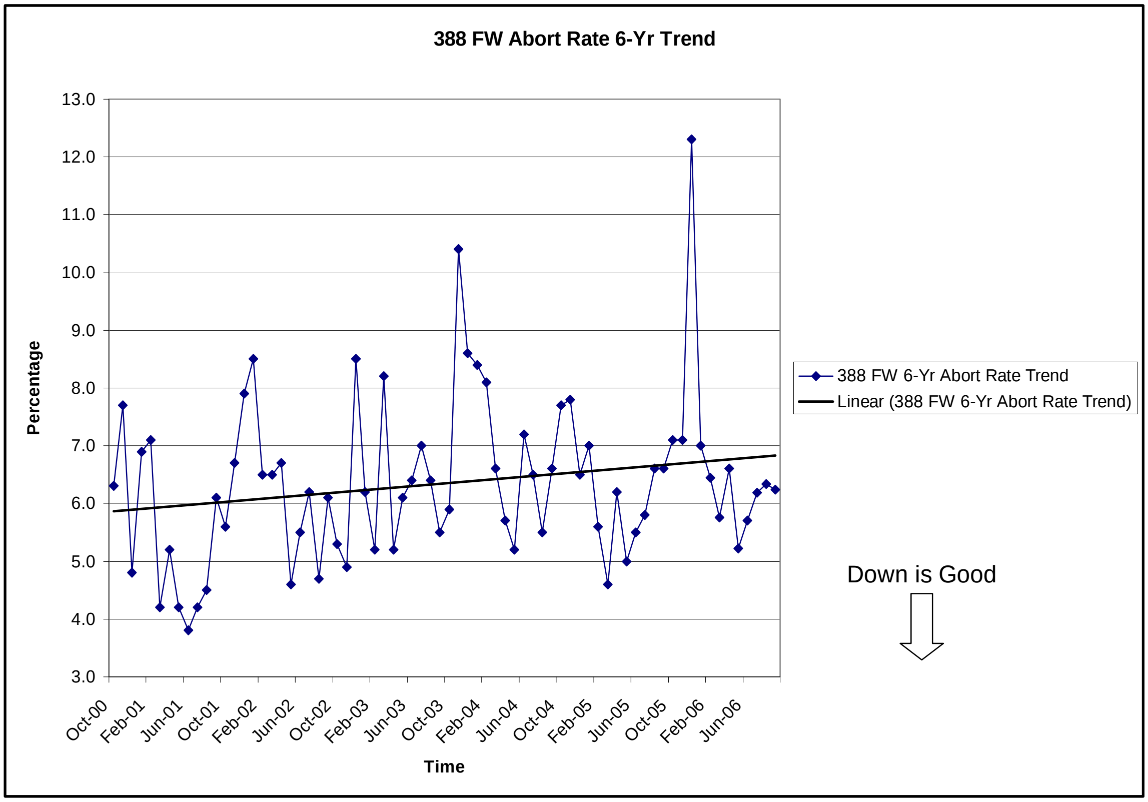


Figure 3. 388 FW Six-Year Abort Rate Trend
Source: Data from 388 FW Analysis Section (Hill Air Force Base, Utah) 9302 Monthly Reports dated October 2000 through September 2006

388 FW Six-Year Scheduling Effectiveness Rate Trend

This maintenance metric is used to assess how well a unit met its flying schedule.[13] There are several things that will detract from a unit's percentage of flying scheduling effectiveness. According to AFI 21-101 these detractors include sorties not flown or that departed late due to: maintenance, supply, operations, weather, higher headquarters tasking, air traffic control management problems, as well as other reasons.[14] The formula used to calculate the flying scheduling effectiveness rate is the number of sorties scheduled minus the total deviations divided by the sorties scheduled times 100 or:

FSE Rate = ((Sorties Scheduled – Total Deviations)/Sorties Scheduled) x one hundred[15]

Referring to the 388 FWs six-year trend in Figure 4 there is an upward trend line. This indicates a positive performance trend. The average FSE rate for the 388 FW during this period was 76.3 percent with the best month in December 2004 when the rate was 91.9 percent and the worst month in February 2001 when the rate was a dismal 50 percent.[16]

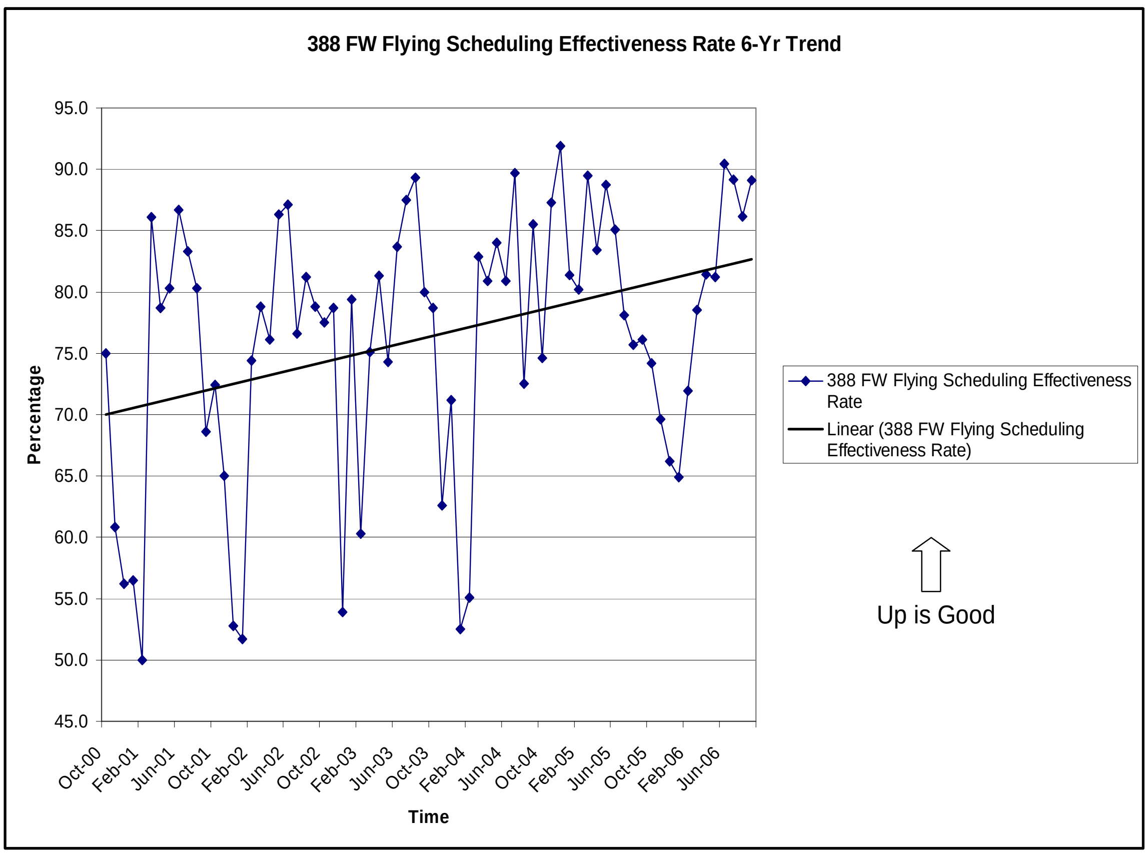


Figure 4. 388 FW Six-Year Flying Scheduling Effectiveness Rate Trend
Source: Data from 388 FW Analysis Section (Hill Air Force Base, Utah) 9302 Monthly Reports dated October 2000 through September 2006

388 FW Six-Year Cannibalization Rate Trend

This maintenance metric is used to measure the percentage of time a maintenance unit cannibalizes a part from one aircraft or engine to another aircraft or engine due to a shortage in supply.[17] The formula used to calculate the cannibalization rate is the number of aircraft and cannibalization actions divided by the total sorties flown times 100 or:

Cannibalization Rate = ((Aircraft Canns + Engine Canns)/Total Sorties Flown) x one hundred[18]

Referring to the 388 FWs six-year trend in Figure 5 there is a steady downward trend line. This indicates a very positive performance trend. The average cannibalization rate for the 388 FW during this period was 8.9 percent with the best month in February 2006 with a mere .9 percent rate and the worst month in December 2002 when the rate reached 19.1 percent.[19]

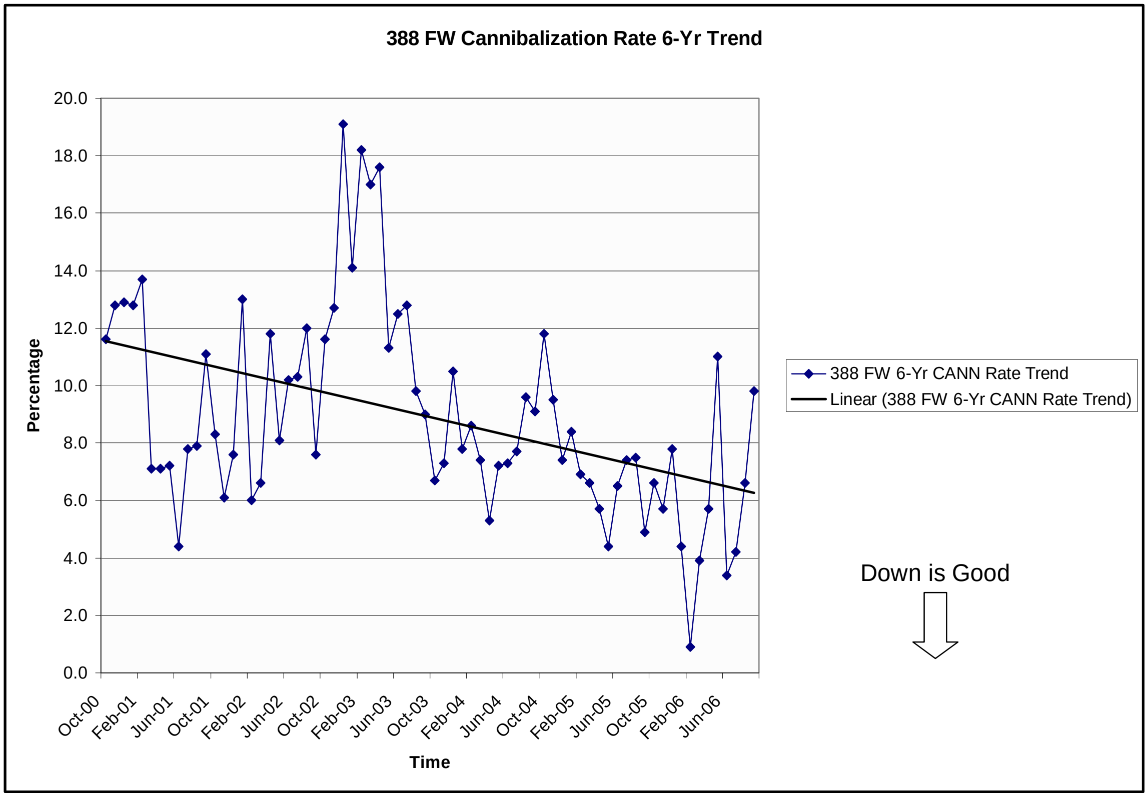


Figure 5. 388 FW Six-Year Cannibalization Rate Trend
Source: Data from 388 FW Analysis Section (Hill Air Force Base, Utah) 9302 Monthly Reports dated October 2000 through September 2006

<u>388 FW Six-Year Repeat and Recur Rate Trend</u>

This maintenance metric is used to measure the percentage of repeating and recurring maintenance discrepancies compared to the number of aircrew reported malfunctions. Its designed purpose is to assess the quality of a unit's maintenance. According to AFI 21-10, a repeat discrepancy is one in which "the same malfunction occurs in a system or subsystem on the next sortie or sortie attempt after the discrepancy originally occurred and was cleared by maintenance."[20] A recurring discrepancy, according to the same AFI, is when "the same system/subsystem malfunction occurs on the 2nd, 3rd or 4th sorties or sortie attempts after the original flight in which the malfunction occurred and was cleared by maintenance."[21] The formula used to calculate the repeat and recur rate is the sum of the number of repeating and recurring discrepancies divided by the total number of pilot reported discrepancies multiplied by 100 or:

Repeat/Recur Rate = ((Repeats + Recurs)/Total Pilot Reported Discrepancies) x one hundred[22]

Referring to the 388 FWs six-year trend in Figure 6 there exists a steady downward trend line. This indicates a very positive performance trend. The average repeat/recur rate for the 388 FW during this period was 5.25 percent with the best month in May 2005 when the rate was just 1.1 percent rate and the worst month in February 2002 when the rate topped out at 10.1 percent.[23]

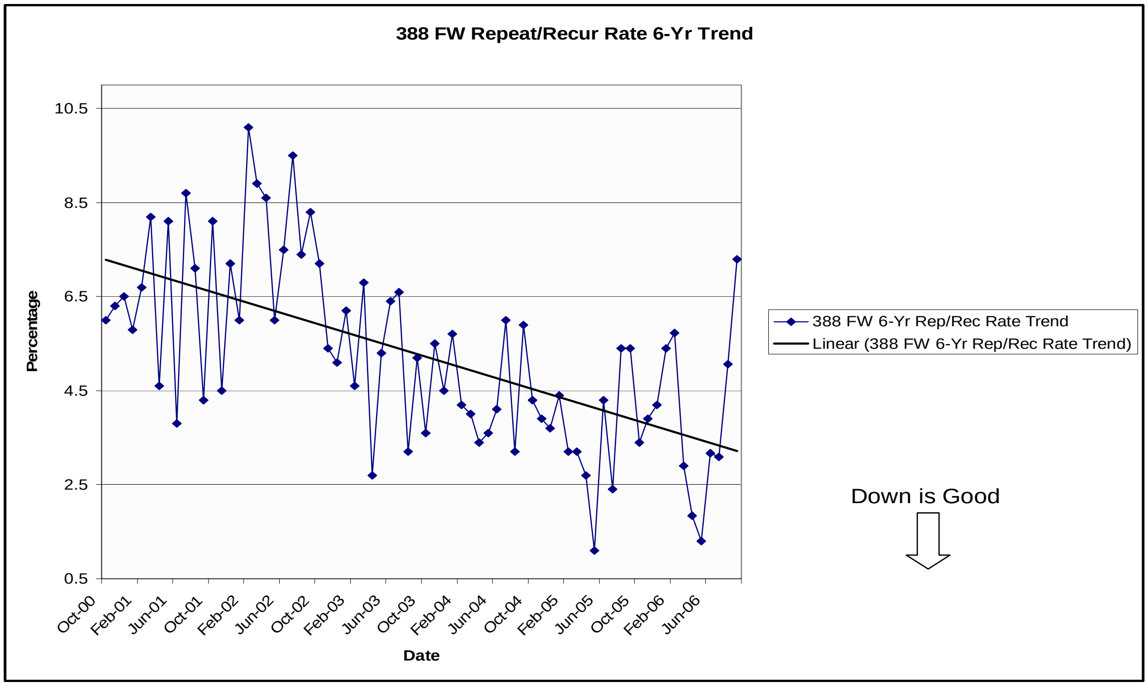


Figure 6. 388 FW Six-Year Repeat and Recur Rate Trend
Source: Data from 388 FW Analysis Section (Hill Air Force Base, Utah) 9302 Monthly Reports dated October 2000 through September 2006

<u>388 FW Six-Year Mission Capable Rate Trend</u>

This maintenance metric is a measure of the percentage of time a unit's aircraft are capable of performing their assigned missions.[24] The formula used to calculate the mission capable rate the sum of the number of fully mission capable and partially mission capable hours divided by the number of possessed hours and then multiplied by 100 or:

Mission Capable Rate = ((FMC Hours + PMC Hours)/Possessed Hours) x one hundred[25]

Referring to the 388 FWs six-year trend in Figure 7 there is a steady upward trend. This indicates very positive performance. The average mission capable rate for the 388 FW during this period was 80.04 percent with the best month in July 2005 with a rate of 88.7 percent and the worst in December 2000 when the rate fell to 70.2 percent.[26]

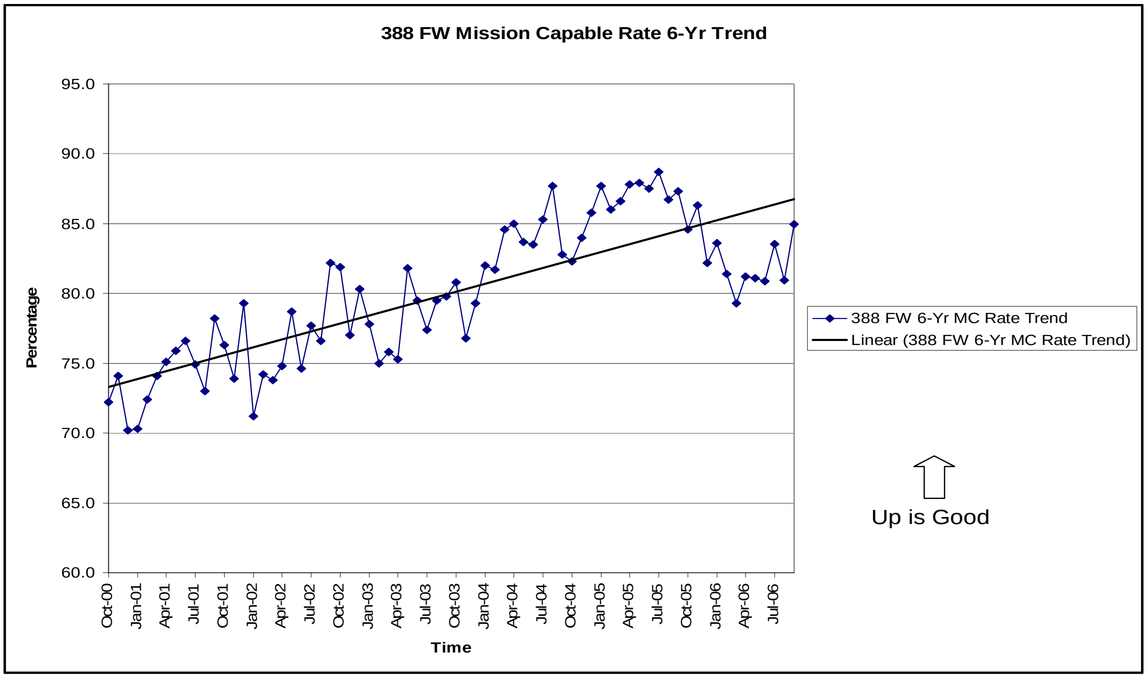


Figure 7. 388 FW Six-Year Mission Capable Rate Trend
Source: Data from 388 FW Analysis Section (Hill Air Force Base, Utah) 9302 Monthly Reports dated October 2000 through September 2006

388 FW Six-Year Nonmission Capable for Maintenance Rate Trend

This maintenance metric is a measure of the percentage of time a unit's aircraft are not capable of performing their assigned missions due to maintenance reasons.[27] The formula used to calculate the nonmission capable for maintenance rate is the sum of the number of nonmission capable for maintenance hours and the nonmission capable rate for maintenance and supply hours divided by the number of possessed hours and then multiplied by 100 or:

Nonmission Capable For Maintenance Rate = ((NMCM Hours + NMCB Hours)/Possessed Hours) x one hundred[28]

Referring to the 388 FWs six-year trend in Figure 8 there is a very steady downward trend line. This indicates a very positive performance trend and is to be expected when referring back to the steady rise in mission capable rate seen in Figure 7. The average nonmission capable for maintenance rate for the 388 FW during this period was 14.26 percent with the best month in July 2005 when the rate fell to 7.1 percent and the worst month in December 2000 when the rate vaulted to 22.1 percent.[29]

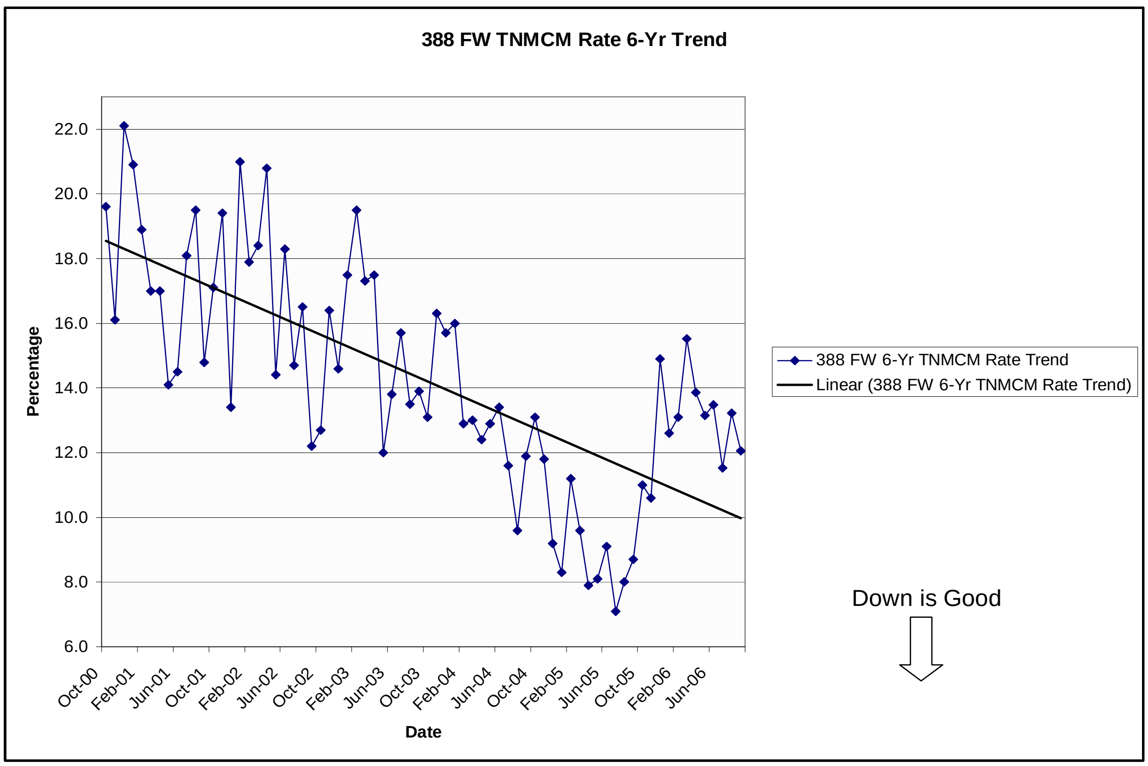


Figure 8. 388 FW Six-Year Nonmission Capable Rate Trend
Source: Data from 388 FW Analysis Section (Hill Air Force Base, Utah) 9302 Monthly Reports dated October 2000 through September 2006

388 FW Six-Year Nonmission Capable for Supply Rate Trend

This maintenance metric is a measure of the percentage of time a unit's aircraft are not capable of performing their assigned missions due to supply reasons.[30] The formula used to calculate the nonmission capable for supply rate is the sum of the number of nonmission capable for supply hours and the nonmission capable rate for maintenance and supply hours divided by the number of possessed hours and then multiplied by 100 or:

Nonmission Capable For Supply Rate = ((NMCS Hours + NMCB Hours)/Possessed Hours) x one hundred[31]

Referring to the 388 FWs six-year trend in Figure 9 there is a very steady downward trend line. This indicates a very positive performance trend and is to be expected when one refers back to both the mission capable rate and nonmission capable rate trend lines in Figures 7-1 and 8-1. The average nonmission capable for supply rate for the 388 FW during this period was 8.72 percent with the best months in June 2005 and November 2005 when the rate dropped to 3.8 percent and the worst month in January 2001 when the rate reached 16.0 percent.[32]

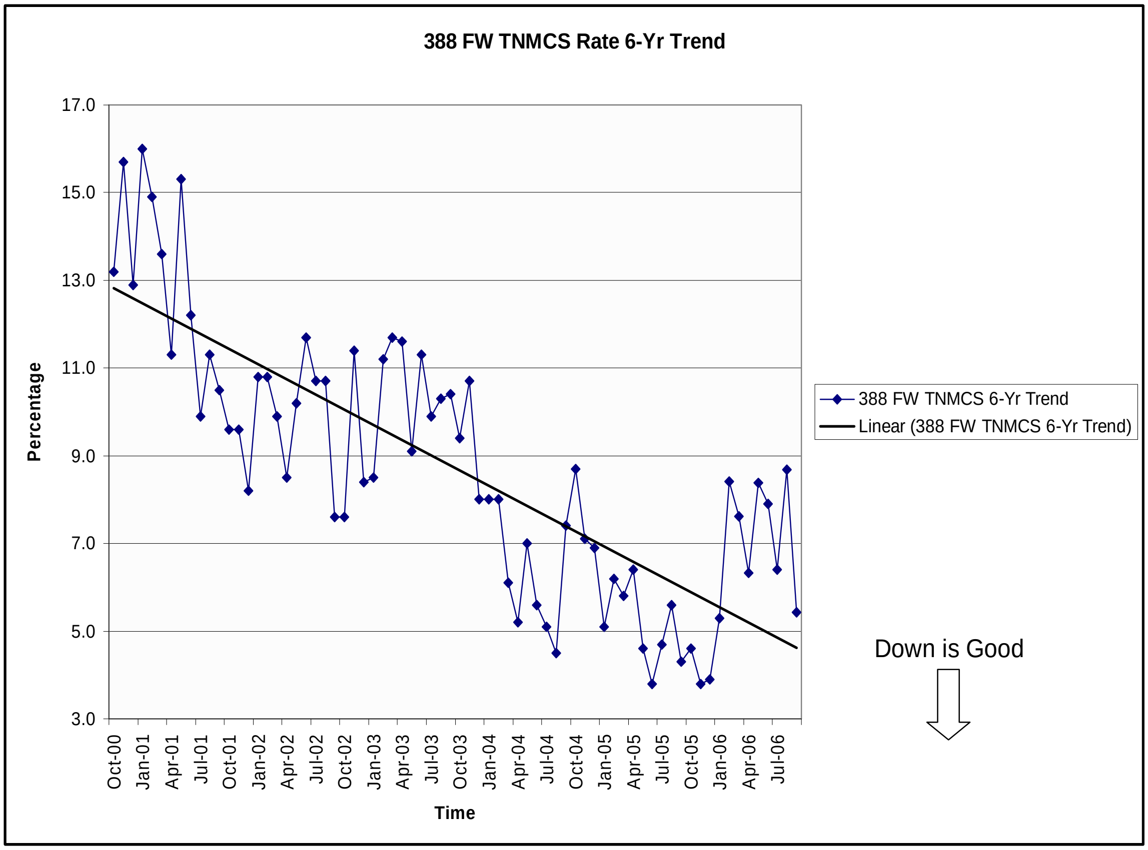


Figure 9. 388 FW Six-Year Nonmission Capable for Supply Trend
Source: Data from 388 FW Analysis Section (Hill Air Force Base, Utah) 9302 Monthly Reports dated October 2000 through September 2006

Phase I Conclusion

Analysis of the metrics above results in a very noticeable difference in the 388 FWs metrics throughout the six year period. With the exception of the aircraft break and abort rates, all of the maintenance metrics trended in the positive direction throughout the evaluation period. The goal for Phase I was to establish if there was a noticeable difference in the maintenance metrics before and after program implementation. The data above demonstrates that this has been established. The next question is whether or not the positive changes in the maintenance metrics of the 388 FW were greater than those of the rest of Air Combat Command's F-16 Fleet. This is the purpose behind Phase II of analysis.

Phase II – Comparison of 388 FW and ACC F-16 Maintenance Metrics

As identified in the beginning of this chapter, the purpose of the Phase II analysis was to take the results of Phase I (388 FW maintenance metrics for FY2000 through FY2006) and compare them with the maintenance metrics for Air Combat Command's entire F-16 fleet. Specifically, a search was made for a difference in the trend lines of the nine maintenance metrics measured in this study. The reason is the comparison and analysis of the trend lines between the 388 FWs and ACCs maintenance metrics that demonstrate the effect of the phase and cannibalization program. If the 388 FWs phase and cannibalization program is worthy of implementation throughout the F-16 fleet (and potentially throughout the rest of the AF's aircraft inventory) then a measurable difference between the 388 FWs and ACCs metrics over time should exist. The results have been placed in the nine charts (figures 10 through 18). To help understand the charts showing these results and metrics, there is an appropriate "Up is Good" or "Down is Good" arrow in the lower right hand corner of all of the charts in Figures 10 through 18.

Comparison of 388 FW and ACC Six-Year Aircraft Break Rate Trends

Referring to Figure 10, both the 388 FWs and ACCs aircraft break rates trended in a negative direction. This is not a positive trend for either agency and is an indicator of diminishing health of their respective aircraft fleets. Much of the blame for this trend has been placed on the increasing age of the Air Force's aircraft fleet vice the performance of its maintenance personnel, as noted in the many publicized testimonials by the SECAF and CSAF before Congress in recent years.[33] Notice also a difference in the slope of the trend lines between the two sets of data.[34] The 388 FWs trend line has a slightly steeper slope than does ACC. It should be noted, however, that the 388 FWs break rate was well below that of ACC for all five years prior to FY2006. But for the one outlier (FY2006) the 388 FWs break rate was better than ACC. Going back, FY2003-FY2005 were the first three years following the implementation of the consolidated phase and cannibalization program at Hill AFB. Looking closer at those three years following FY2002, a more significant drop in aircraft break rate exists when compared to ACC. This may indicate the positive impact the consolidated phase and cannibalization program had on the 388 FWs aircraft break rate metric after program implementation.

Additionally, when referring to the ACC versus 388 FW F-16 Comparison, the average break rate for the 388 FW for FY2001-FY2002 and FY2003-FY2006 are better than ACCs for the same two time periods. While both agencies' rates rose (a negative performance indicator), the 388 FWs rate rose at a pace less than that of ACC.

Further analysis into the reasons behind the 388 FWs significant rise in aircraft break rate from 10 percent in FY2005 to over 13 percent in FY2006 is warranted. However, for the purposes of this study, the 388 FW had better overall metrics and a far more significant rise in relative growth performance in this category (See Table 2).

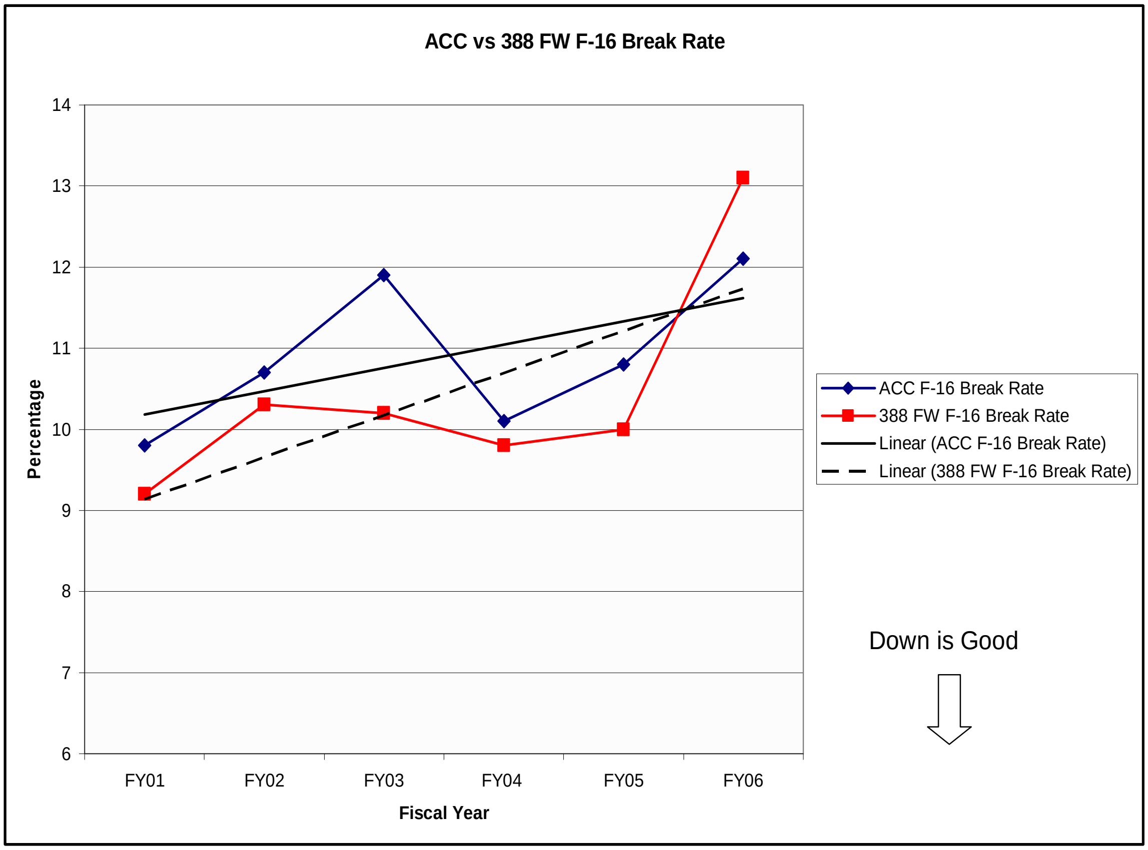


Figure 10. ACC versus 388 FW F-16 Break Rate
Source: Data from 388 FW Analysis Section (Hill Air Force Base, Utah) 9302 Monthly Reports dated October 2000 through September 2006 and Air Combat Command (Langley Air Force Base, Virginia) Ten-Year Lookback Product dated May 2007.

Comparison of 388 FW and ACC Six-Year Eight-Hour Fix Rate Trends

Referring to Figure 11, the eight-hour fix rate has been higher than that of the 388 FW throughout the entire time period.[35] However, during the same analysis period, ACCs trend line moved in the negative direction while the 388 FWs trend line rose sharply in the positive direction.[36] The 388 FWs drastic improvement in the 8-hr fix rate came in the four years following implementation of the program, though that improvement did not begin in the year immediately following program implementation.

Instead the upswing in 8-hr fix rate in the 388 FW did not begin until FY2004. Despite this fact, this is still an indicator of the positive impact of the phase and cannibalization program on this maintenance metric. Again, there is a sharp decline in the 8-hr fix rate for both ACC and the 388 FW between FY2005 and FY2006. This too warrants further analysis. For the purpose of this study, I concluded ACC had the better metric but the 388 FW had better relative growth performance in this category (See Table 2).

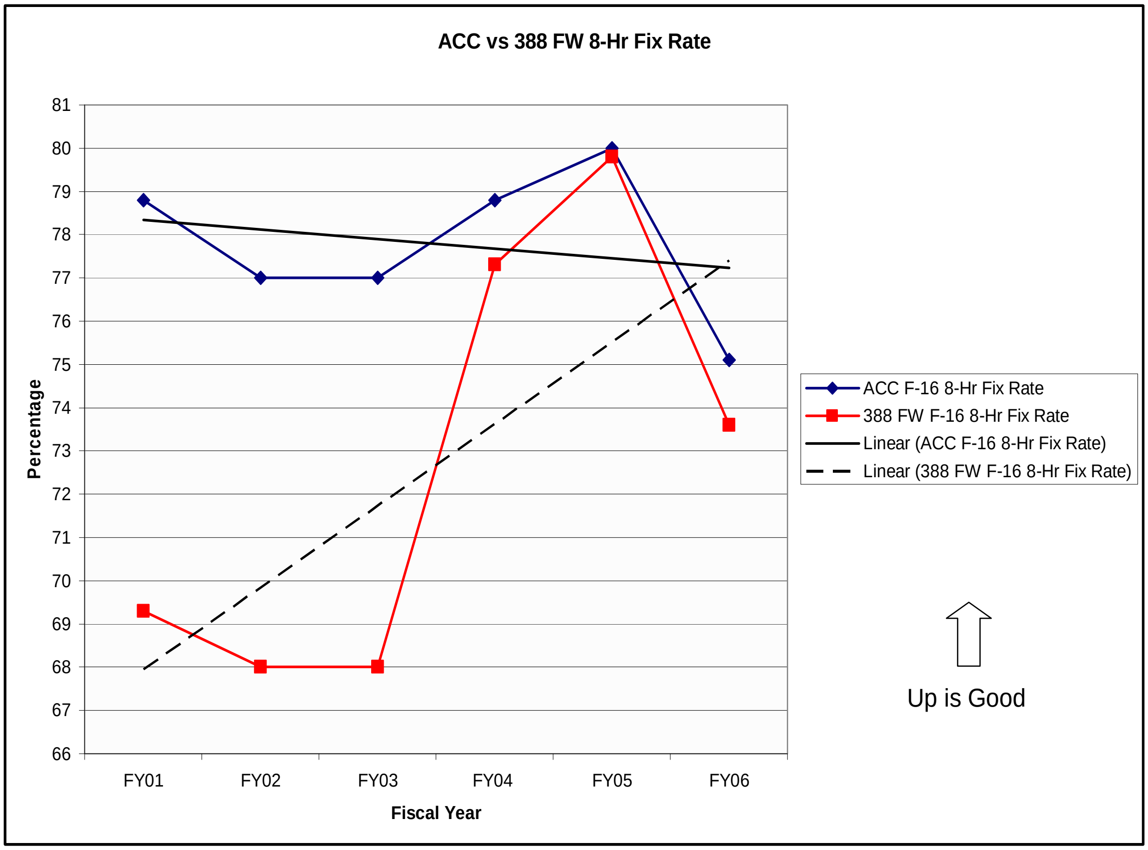


Figure 11. ACC versus 388 FW Eight-Hour Fix Rate
Source: Data from 388 FW Analysis Section (Hill Air Force Base, Utah) 9302 Monthly Reports dated October 2000 through September 2006 and Air Combat Command (Langley Air Force Base, Virginia) Ten-Year Lookback Product dated May 2007.

Comparison of 388 FW and ACC Six-Year Abort Rate Trends

Referring to Figure 12, notice the steady upward trend line for both the 388 FW and ACC.[37] This indicates a negative performance trend in both agencies and is a sign of diminishing health of their F-16 fleets. Overall, ACCs abort rate was better, on average, than the 388 FW. Though there is a very slight difference in the slope of the trend lines, the two agencies trend lines are in near parallel lockstep with one another. In my opinion, this is not conclusive evidence of the positive or negative impact of the consolidated Phase and cannibalization program. Additionally, there were no significant outliers that skewed the data and unlike the aircraft break and the 8-hr fix rates, there was not a significant difference in either agencies metric between FY2005 and FY2006. For the purposes of this study, the consolidated Phase and cannibalization program seems to have had little effect on the abort rate (See Table 2).

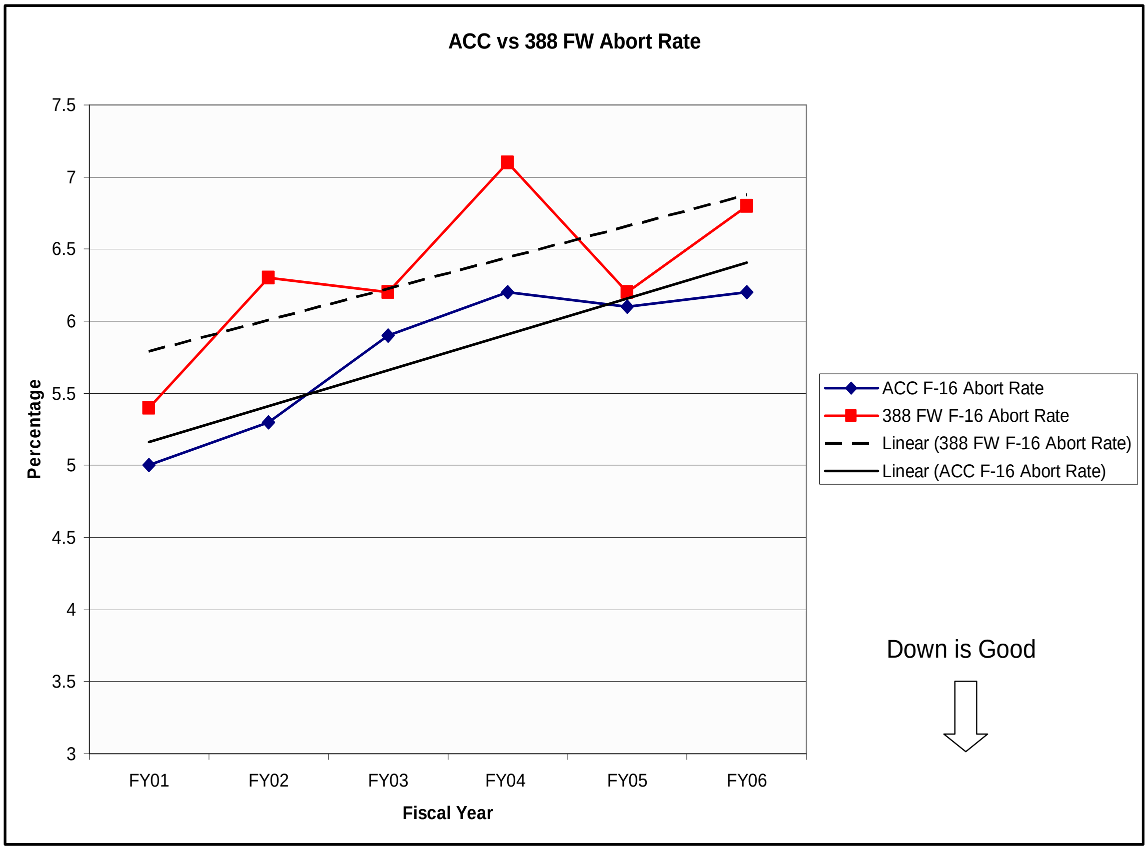


Figure 12. ACC versus 388 FW Abort Rate
Source: Data from 388 FW Analysis Section (Hill Air Force Base, Utah) 9302 Monthly Reports dated October 2000 through September 2006 and Air Combat Command (Langley Air Force Base, Virginia) Ten-Year Lookback Product dated May 2007.

Comparison of 388 FW and ACC Six-Year Flying Scheduling Effectiveness Rate Trends

Referring to Figure 13, there is a steady upward trend line for the 388 FW while ACCs trend is in a slow but steady decline.[38] This indicates a positive performance trend, improved aircraft reliability and aircraft scheduling techniques for the 388 FW. Again, ACCs average flying scheduling effectiveness rate was higher than that of the 388 FW during the reporting period. However, in the last two years the 388 FWs performance has exceeded that of ACC. Additionally, note the sharper rise in flying scheduling effectiveness rate in the 388 FW compared to ACC during the evaluation period. Though the 388 FW beat ACCs average rate only twice, it is noteworthy that the trend lines indicate the 388 FW will soon pass ACCs average in the near future. This is an indicator of a positive impact of the consolidated phase and cannibalization program on the 388 FWs flying scheduling effectiveness rate which led me to conclude the 388 FWs relative growth performance in this category exceeded that of ACC (See Table 2).

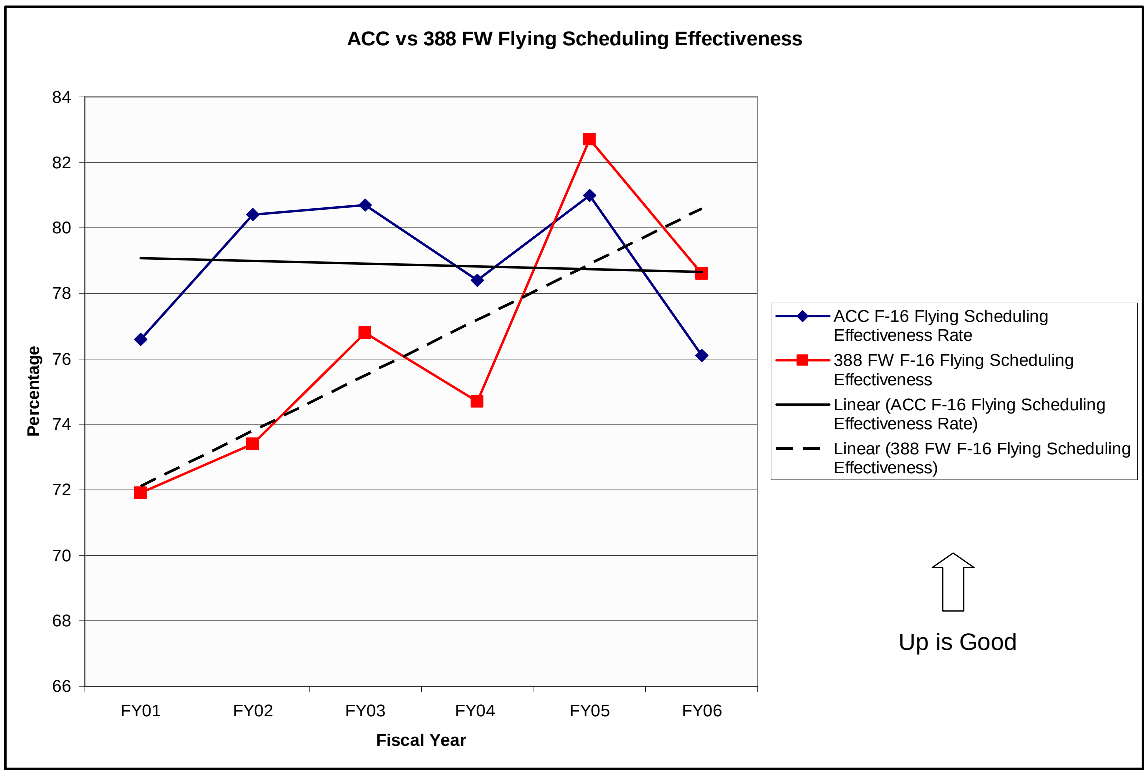


Figure 13. ACC versus 388 FW Flying Scheduling Effectiveness
Source: Data from 388 FW Analysis Section (Hill Air Force Base, Utah) 9302 Monthly Reports dated October 2000 through September 2006 and Air Combat Command (Langley Air Force Base, Virginia) Ten-Year Lookback Product dated May 2007.

Comparison of 388 FW and ACC Six-Year Cannibalization Rate Trends

Referring to Figure 14, notice the steady downward trend line for both the 388 FW and ACC. ACCs overall average cannibalization rate was less than that of the 388 FW and each agency had a significant rise in cannibalization rate in FY2003.[39] (In my opinion this was most likely due to the start of Operation Iraqi Freedom). The overall trend for both agencies indicates an improvement in supply parts availability and cannibalization management. There is a very slight difference in the slope of the trend lines and each agency seems to be in relative lockstep with one another. I determined the slight difference in slope to be inconclusive as an indicator of the impact of the consolidated Phase and cannibalization program (See Table 2).

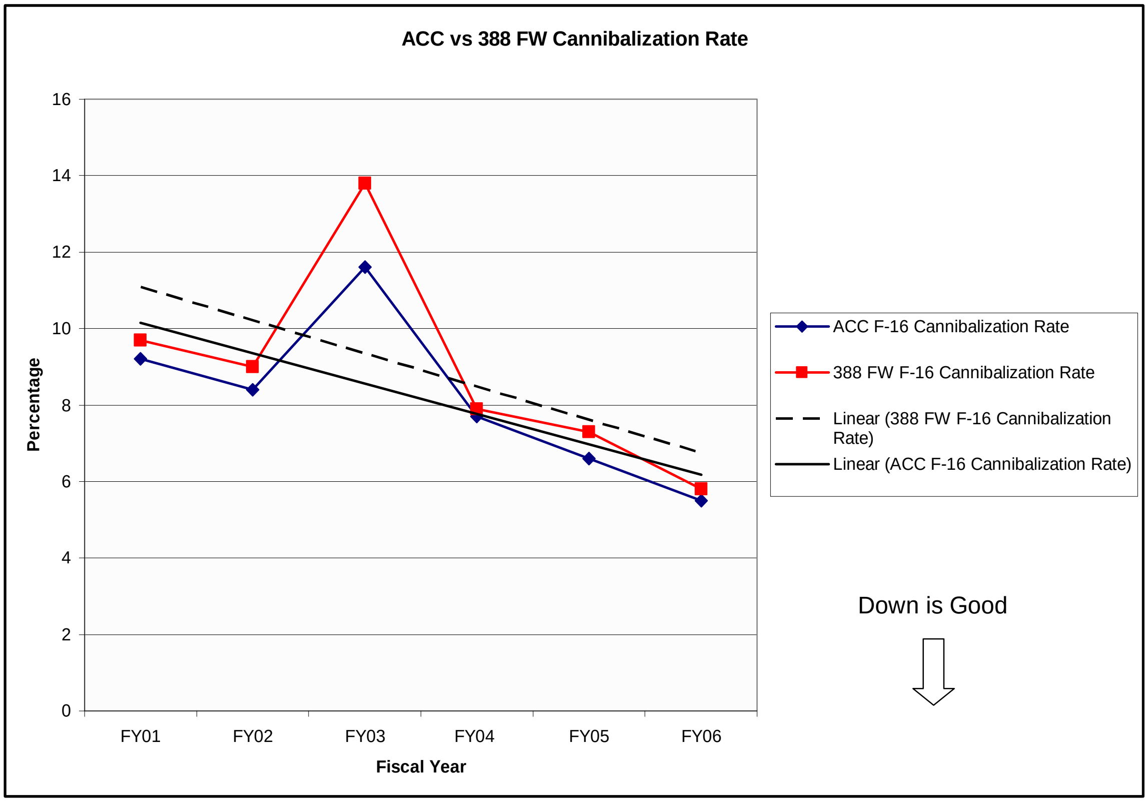


Figure 14. ACC versus 388 FW Cannibalization Rate
Source: Data from 388 FW Analysis Section (Hill Air Force Base, Utah) 9302 Monthly Reports dated October 2000 through September 2006 and Air Combat Command (Langley Air Force Base, Virginia) Ten-Year Lookback Product dated May 2007.

Comparison of 388 FW and ACC Six-Year Repeat and Recur Rate Trends

Referring to Figure 15, there is a very steady downward trend line for the 388 FW.[40] This indicated a very steady and positive improvement in the repeat/recur rate for the 388 FW during the evaluation period. It is also noteworthy that this trend began to improve significantly for the 388 FW in the four years since the consolidated Phase and cannibalization program was implemented. The difficulty here is that a conclusive comparison with ACC was not possible at the time of this thesis. ACC only started tracking this rate in FY2005 so no previous data exists for the F-16 fleet in ACC prior to that year. However, the 388 FW voluntarily tracked this rate during this reporting period. I included the data in this study so some comparison between ACC and the 388 FW could be conducted. For the purposes of this study, I concluded that the 388 FWs overall metric and its relative growth performance trend both exceed those of ACC (See Table 2).

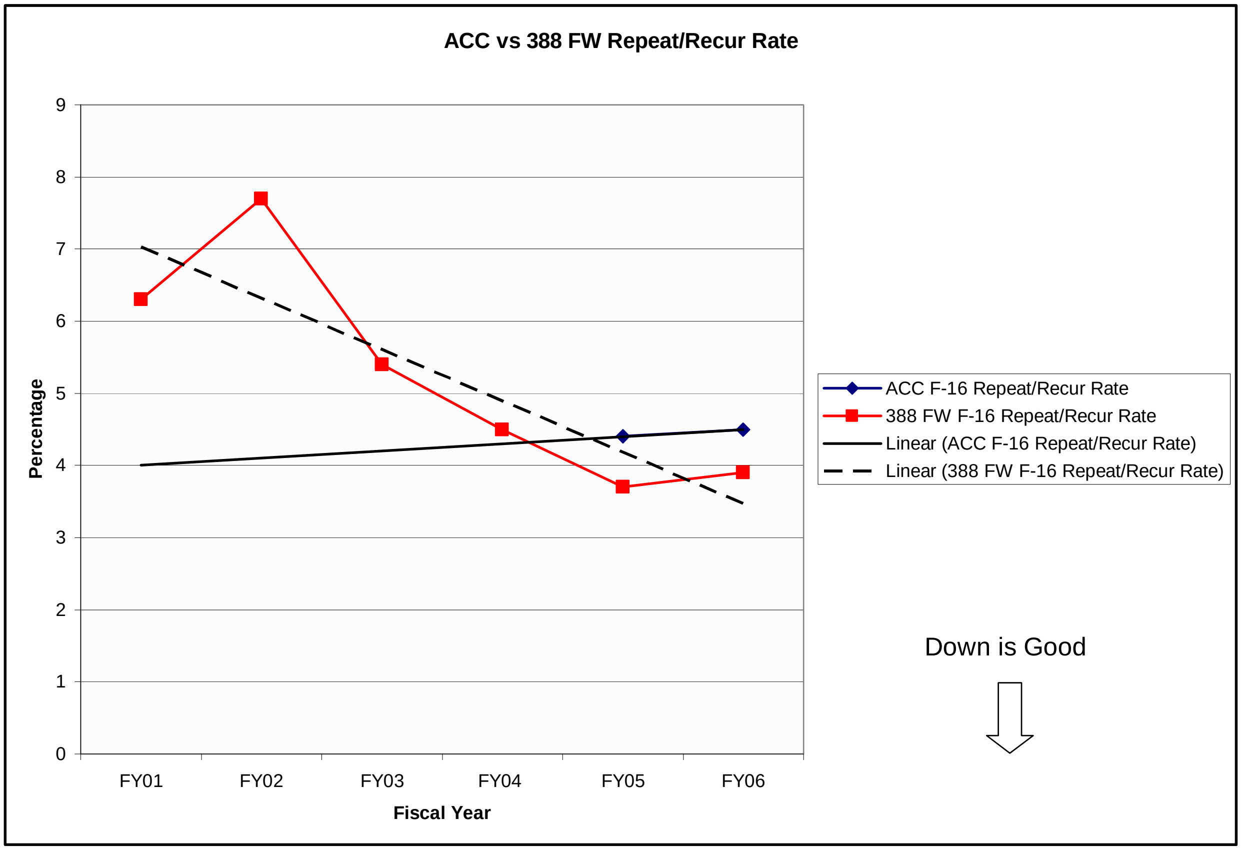


Figure 15. ACC versus 388 FW Repeat and Recur Rate
Source: Data from 388 FW Analysis Section (Hill Air Force Base, Utah) 9302 Monthly Reports dated October 2000 through September 2006 and Air Combat Command (Langley Air Force Base, Virginia) Ten-Year Lookback Product dated May 2007.

Comparison of 388 FW and ACC Six-Year Mission Capable Rate Trends

Referring to Figure 16, notice the very steady upward trend line for both ACC and the 388 FW.[41] This indicates a very positive trend for both agencies. It is noteworthy that during this period, not only did the 388 FW narrow the gap, but they surpassed ACCs average in FY2005 and FY2006. This caused the 388 FWs trend line to be measurably higher than that of ACC even though ACCs overall average during the entire evaluation period was greater than that of the 388 FW (See Table 2). This is a positive indicator of the impact of the consolidated phase and cannibalization program. The sharp rise in the 388 FWs trend line coupled with their higher MC Rate for the last two years was reason for me to conclude that the 388 FW had a better relative growth performance in this category (See Table 2).

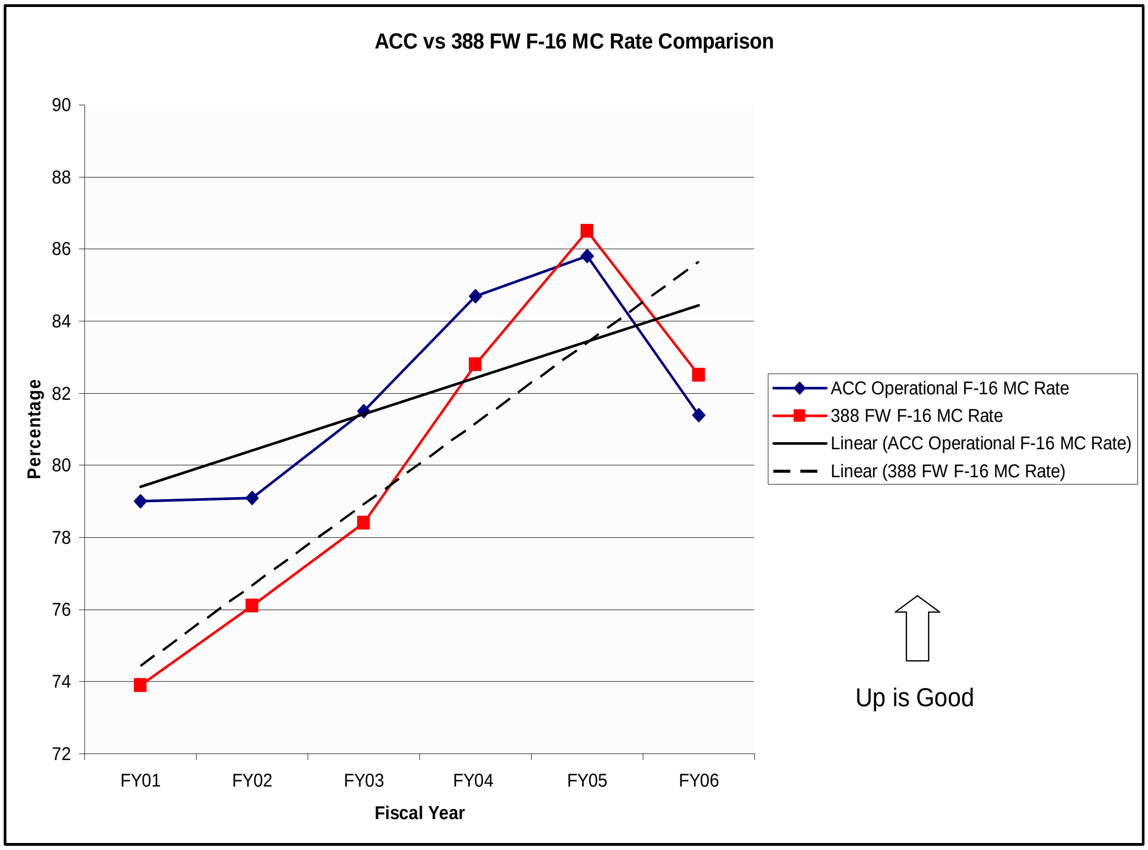


Figure 16. ACC versus 388 FW Mission Capable Rate
Source: Data from 388 FW Analysis Section (Hill Air Force Base, Utah) 9302 Monthly Reports dated October 2000 through September 2006 and Air Combat Command (Langley Air Force Base, Virginia) Ten-Year Lookback Product dated May 2007.

Comparison of 388 FW and ACC Six-Year Nonmission Capable for Maintenance Rate Trends

Referring to Figure 17, there is a very steady downward trend line for both ACC and the 388 FW. This indicates a very positive performance trend for both agencies. Additionally, the 388 FWs trend line shows a complete narrowing of the gap, in fact surpassing ACCs rate in FY2006. This is a positive indicator of the impact of the consolidated phase and cannibalization program. The sharp rise in NMCM rate for both the 388 FW and ACC between FY2005 and FY2006 warrants further study. For the purposes of this study, I concluded that ACCs overall average throughout the reporting period was better than the 388 FW while the 388 FWs relative growth performance in this category exceeds that of ACC (See Table 2).

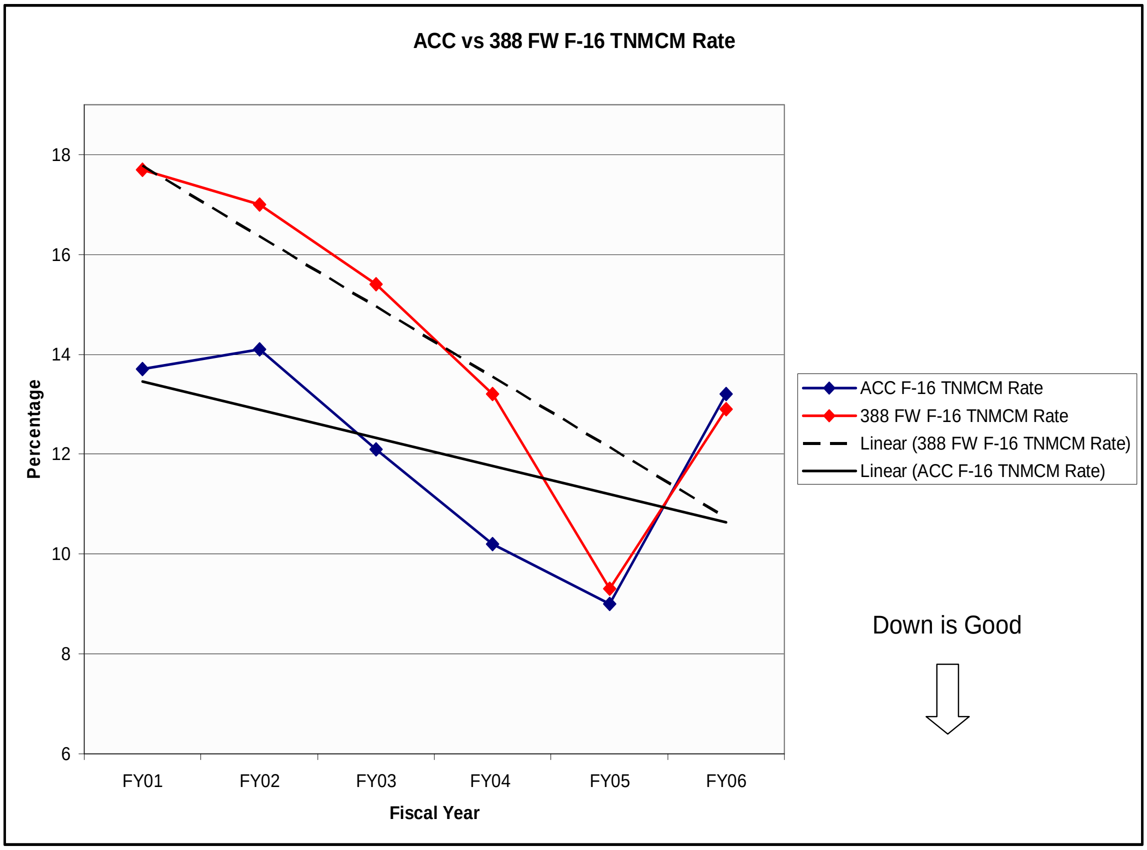


Figure 17. ACC versus 388 FW Nonmission Capable Rate
Source: Data from 388 FW Analysis Section (Hill Air Force Base, Utah) 9302 Monthly Reports dated October 2000 through September 2006 and Air Combat Command (Langley Air Force Base, Virginia) Ten-Year Lookback Product dated May 2007.

Comparison of 388 FW and ACC Six-Year Nonmission Capable for Supply Rate Trends

Referring to Figure 18, notice the very steady downward trend line for both ACC and the 388 FW.[42] This indicated a very positive performance trend for both agencies and was indicative of improved supply parts availability. Additionally, the 388 FWs average exceeded that of ACC three times during the evaluation period and equaled it one other time. Additionally, the trend line for the 388 FW bested ACC with a sharper decline in TNMCS rate. For the purposes of this study, I concluded the relative growth performance in this category was better in the 388 FW (See Table 2).

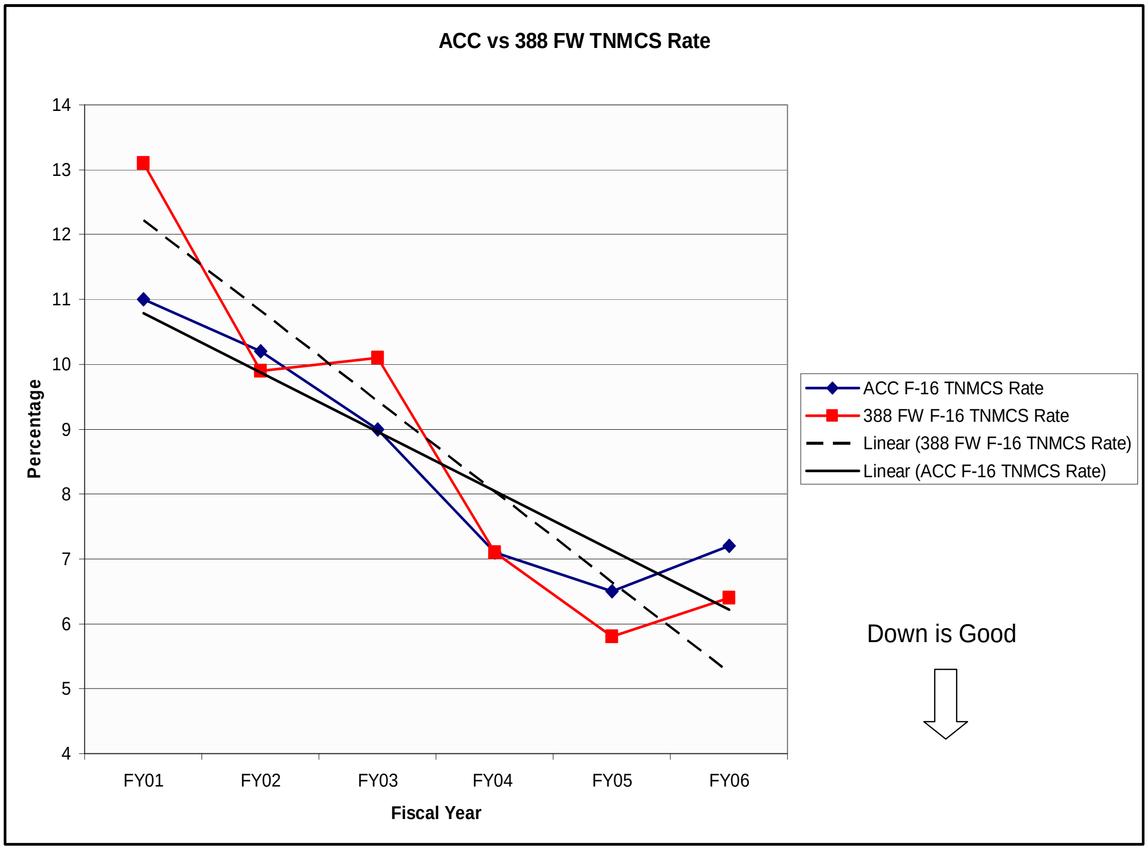


Figure 18. ACC versus 388 FW Nonmission Capable for Supply Rate
Source: Data from 388 FW Analysis Section (Hill Air Force Base, Utah) 9302 Monthly Reports dated October 2000 through September 2006 and Air Combat Command (Langley Air Force Base, Virginia) Ten-Year Lookback Product dated May 2007.

Phase II Conclusion

As identified above, the purpose of the Phase II analysis was to compare the 388 FWs and ACCs maintenance metrics to assess the impact of the 388 FWs phase and cannibalization program. Analysis of the metrics and charts above reveals that ACC had better overall metrics in six of nine categories throughout the reporting period. But what it also shows is the 388 FW gained rapidly in performance in comparison to ACC after program implementation of its consolidated phase and cannibalization program in 2002. There were a few key metrics – Cannibalization, Abort, and Break Rates – where the comparison between ACC and the 388 FW were assessed as neutral. However, in the other six metrics the assessment was noticeably in favor of the 388 FW. These results were consolidated and placed in a comparison table located in Chapter 5 Page 76, and leads us to Phase III of the analysis.

Phase III – Author's Assessment Table of 388 FW vs. ACC Comparison

The purpose of Phase III was to place the results of the Phase II analysis into a comparison table to aid me in making a final assessment of the impact of the consolidated phase and cannibalization program on the 388 FWs key metrics. This table is located in the table in Chapter 5, page 76, and shows ACC received six "+" marks in its columns while the 388 FW received eight "+" marks. These "+" markings were my assessment of which agency was performing better in each key maintenance metric in relation to *better overall metrics* and *relative growth* performance following program implementation. The results, annotated in this chart, will be further discussed in chapter 5.

[1]Air Force Instruction 21-101, 23.

[2]Ibid., 24.

[3]Ibid., 24.

[4]Ibid., 25.

[5]Ibid., 25.

[6]U.S. Air Force. 388th Fighter Wing, *Monthly 9302 Reports;* Hill Air Force Base, Utah; Department of the Air Force, 1998-2006.

[7]Air Force Instruction 21-101, 26.

[8]Ibid., 26.

[9]388th Fighter Wing, *Monthly 9302 Reports.*

[10]Air Force Instruction 21-101, 24.

[11]Ibid., 24.

[12]388th Fighter Wing, *Monthly 9302 Reports.*

[13]Air Force Instruction 21-101, 26.

[14]Ibid., 26.

[15]Ibid., 27.

[16]388th Fighter Wing, *Monthly 9302 Reports.*

[17]AFI 21-101, 25.

[18]Ibid., 27.

[19]388th Fighter Wing, *Monthly 9302 Reports.*

[20]Air Force Instruction 21-101, 29.

[21]Ibid., 29.

[22]Ibid., 27.

[23]388th Fighter Wing, *Monthly 9302 Reports.*

[24]Air Force Instruction 21-101, 27.

[25]Ibid., 27

[26]388th Fighter Wing, *Monthly 9302 Reports.*

[27]Air Force Instruction 21-101, 28.

[28]Ibid., 28.

[29]388th Fighter Wing, *Monthly 9302 Reports.*

[30]Air Force Instruction 21-101, 28.

[31]Ibid., 28.

[32]388th Fighter Wing, *Monthly 9302 Reports.*

[33]Air Force Web Site.

[34]U.S. Air Force, Air Combat Command Directorate of Maintenance and Logistics, *Ten Year Lookback*, (Langley Air Force Base, Virginia; Department of the Air Force), 2007.

[35]ACC *Ten Year Lookback*, 6.

[36]Ibid.

[37]Ibid.

[38]Ibid.

[39]Ibid.

[40]Ibid.

[41]Ibid.

[42]Ibid.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

As identified in chapter 1, this thesis focuses on the effects of consolidating the F-16 phase and cannibalization aircraft in the 388 FW on their key maintenance indicators. I hypothesize this program would significantly increase the 388th Fighter Wing's mission-capable rate and have positive effects on the other key maintenance indicators. I considered a significant increase to be an overall rise in the mission capable rate of 1.7 percent or greater in comparison to that of ACC.

Assessment of Program Impact

There is no doubt ACCs overall metrics were consistently better than those in the 388 FW for most of the key maintenance metrics. The exceptions to this were the aircraft break rate and the repeat and recur rate, in which the 388 FW had better metrics, and the nonmission capable for supply rate in which the difference was negligible.

To a certain degree this was an expected outcome. Referring back to chapter 1, one of the main reasons for the implementation of the consolidated phase and cannibalization program was the 388 FW commander's desire to improve the readiness rate (mission capability) of the 388th Fighter Wing and maximize the availability of aircraft for the daily flying mission. His desire for improvement manifested from the knowledge that the mission capable (MC) rate in the 388 FW had consistently hovered around 75 percent for several years while ACCs average was much higher at 79 to 80 percent. The lagging indicator of MC is a result of the leading indicators. If the lagging indicator is low then there is strong correlation the leading indicators will also be low.

Additionally, even at the time of program implementation, there was an expectation the 388 FW would not be able to narrow the gap between its metrics and those of ACC immediately. Any program with a designed purpose of increasing the bottom line--in this case performance vice profit--there is an expectation of incremental improvement as opposed to immediate growth.

A final reason why I expected ACCs metrics to be higher was due to the larger sample size of aircraft in ACC vice the 388 FW. Due to the larger sample size the impact (positive or negative) to the maintenance metrics resulting from one of many mitigating factors in one air wing--such as weather, leadership, mission, and age of aircraft fleet--resulted in a smaller impact to the overall metric of ACC. Conversely, the impact (positive or negative) to the 388 FWs maintenance metrics resulting from those same mitigating factors was greater because they only impacted one wing. Therefore, it was expected that not only would ACCs metrics be better than the 388 FW overall, they would also be more consistent as well. This is the reason why I included a relative growth in performance assessment as part of the comparison.

The relative growth in performance assessment was an attempt to demonstrate the improvement (or decline) in the nine key maintenance metrics in the 388 FW compared to those of ACC. The relative growth was a combination of an assessment of the slope of the trend lines and a numerical assessment of the average of the metrics in each agency from FY2003 through FY2006 (the period of time after program implementation). A significant difference in these metrics is a strong indicator of the impact of the phase and cannibalization program on key maintenance metrics.

Taking this relative growth in performance assessment into consideration, there is little doubt the 388 FWs growth in performance in six of the nine key maintenance metrics was significantly better than that of ACC. Additionally, the other three maintenance metrics were assessed to be neutral (no significant difference between ACC and the 388 FW.) The table 2 shows the comparison of these metrics.

Table 2. Relative Growth in Performance

	388 FW FY01-02	**388 FW FY03-06**	**Delta**		**ACC FY01-02**	**ACC FY03-06**	**Delta**		
MC	75	82.55	7.55	+	79.05	83.35	4.3		Up is Good
TNMCM	17.35	12.7	4.65	+	13.9	11.13	2.77		Down is Good
TNMCS	11.5	7.35	4.15	+	10.6	7.45	3.15		Down is Good
BREAK	9.75	10.78	-1.03*	O	10.25	11.23	-0.98*	o	Down is Good
8 HOUR FIX	68.65	74.68	6.03	+	77.9	77.73	0.17		Up is Good
ABORT	5.85	6.58	-0.73*	O	5.15	6.1	-0.95*	o	Down is Good
FSE	72.65	78.2	5.55	+	78.5	79.05	0.55		Up is Good
CANN	9.35	8.7	0.65	O	8.8	7.85	0.95	o	Down is Good
Rep/Rec	7	4.38	2.62	+	N/A	4.45	N/A		Down is Good

* "-" decline in performance "+" agency with better metric "o" negligible difference

Table 2 lends strong support for my hypothesis that the impact of the consolidated phase and cannibalization program in the 388 FW would increase the 388 FWs MC rate by more than one point seven percent and would also have positive impact on the other key maintenance metrics. The 388 FW has significantly narrowed the gap in performance with ACC. Additionally, referring to Chapter 4, they have surpassed ACC in some metrics within the last couple of years.

Second and Third Order Effects of Program Implementation

The impact of the consolidated phase and cannibalization program goes well beyond the statistical analysis and comparison of the key maintenance metrics. There are a myriad of additional benefits to this program. The following paragraphs describe the benefits addressed in the original concept brief to the 388 FW Commander.

First and foremost is the drastically improved management of the cannibalization and phase aircraft within the wing. This is especially true with cannibalization. The former ad-hoc process turned into a very well managed and consistent program. Both cannibalization aircraft are constantly monitored and their status is known at all times – no such program existed prior to this in any of the three fighter squadrons or AMUs and if it did it was inconsistent. The schedule of aircraft input and output is more predictable as well as centrally managed by the Maintenance Group. The aircraft are also rebuilt by the same personnel that removed the parts in the first place minimizing rebuild time since the personnel are more familiar with their own work. Several former Maintenance Group Commanders lauded the program for this reason. In the words of one senior maintenance leader from the 388 FW – Lt Col (select) Dean Blake former squadron commander of the 388th component maintenance squadron from 2004-2006 – "it was the best phase and cannibalization management program I've seen in my entire career."

A second benefit is the management of the fleets Time Compliance Technical Order (TCTO), Time Compliance Inspection (TCI) and One-Time Inspection (OTIs) programs. These inspections and modifications are requirements that must be completed on the aircraft fleet. They are usually monitored by aircraft tail number and have an associated date or time required for compliance. While most maintenance agencies attempt to perform several of these requirements during a phase and cannibalization input it was not always done when possible. In some squadrons, and wings, this was a very well managed activity. In others it was not. The phase and cannibalization program includes the requirement to perform 100 percent of these inspections and modifications. This serves to "base-line" the fleet and provides the AMU with an aircraft that is 100 percent mission ready upon output.

The flexibility of the program also allows for maintenance leaders to better train and manage their less experienced personnel. A brand new maintenance technician can be assigned to the phase and cannibalization dock for a few days, several weeks, or even months to provide them an opportunity to gain practical on-the-job experience to help their development as technicians. While this is also done in the AMUs, the opportunity for some of the more in-depth and complicated repairs are not always available because the repair may not be needed on any of that unit's aircraft. In cases where more complex repairs are needed often the demands of the daily flying operation may negate the training opportunity. In the phase and cannibalization dock however there is a higher probability of these maintenance repair requirements due to the depth of parts removal and system operational checks needed. Additionally, the environment is far more conducive to training than the flightline environment. The training opportunities and proficiency are not reserved just for the younger technicians. Due to the volume and consistency of these in-depth repairs, several of the more seasoned technicians have gained valuable experience and proficiency in some very complicated maintenance repairs as a result of this program.

Another benefit is the ownership and buy-in that the technicians in the phase and cannibalization dock due to the implementation of the “first flight out of phase or cannibalization” requirement. This first flight out of phase or cannibalization status is a very visible report card for the technicians and leadership of the phase and cannibalization program. For the aircraft crew chiefs, the first flight helps to maintain their level of proficiency in one of their core tasks – launching and recovering aircraft sorties. Additionally, for all of the technicians, crew chief and specialist, it gives them a sense of purpose for the work that they do. This buy-in manifests itself into pride in performance and heightened morale and has improved the quality of the aircraft coming out of phase and cannibalization.

Inherent in the consolidation of the phase and cannibalization program are the economies of scale achieved by combining manpower and requirements. As learned throughout this thesis, the phase and cannibalization aircraft were reduced from three to two. As a result, the manpower needed to maintain these assets was also reduced by an essentially equivalent factor. This can be measured in terms of both manpower assigned as well as man-hours needed to perform functions of management, repair, rebuild, and maintenance of the phase and cannibalization processes. Additionally, the phase and cannibalization has dual-hatted several of its personnel to perform maintenance, repair, and management functions for both the phase and cannibalization aircraft and incorporated programs that used to be separate functions. This was a great leap forward in getting closer to maximizing the capacity/capability of the personnel assigned to the program.

Deciphering the exact reduction in the number of personnel and man-hours resulting from this new program is a tremendously complex task. There are so many factors involved that a subject matter expert is needed to ascertain the tangible benefit. Not only is it beyond the scope of this thesis but it is also, admittedly, well beyond my capability to attempt. Instead, I suggest a manpower study be commissioned by the Air Force to assess the monetary savings and performance benefits of the program.

Finally, all of the tangible and intangible benefits discussed above as well as the increase in mission capability/readiness of the 388 FWs fleet equate to cost savings. Savings in manpower, equipment, and process time are the key savings. There is also a value to be applied to an aircraft fleet maintained at a heightened state of readiness. Again, assessing the actual cost savings is well beyond the scope of this thesis and my capability. Instead, I suggest including the cost savings with the manpower study conducted by an independent source.

Air Force Budget Initiatives to Fund Future Procurement and Acquisition Programs

The military is facing some significant challenges in the world today. The global war on terror is accelerating the need to replace our already aging aircraft fleet as Air Force aircraft continue to accumulate flying hours at an alarming rate. This in itself is a challenge but becomes more difficult when coupled with the budgetary realities of today. According to General Bruce Carlson, Commander of Air Force Materiel Command, “the global war on terror costs $318 million a day, budgets are forecast to decline and buying power is reduced with rising costs."[1] This fact is forcing the USAF to look at alternative methods to get the most out of every defense dollar.

In February 2006, the Secretary of the Air Force, the honorable Michael W. Wynne, initiated a program called Air Force Smart Operations for the 21st Century.[2] Also called, AFSO-21, it is a program designed to look at processes throughout the USAF from beginning to end and identify how they can be done more efficiently or, in the case of a non-value added processes, eliminated.[3] To show how important the program is to the USAF's future, the USAF established an AFSO-21 office at the Pentagon and placed a general officer in charge as director in order to provide top-level guidance for AFSO-21 initiatives.[4]

In my opinion, the consolidated Phase and cannibalization program established in the 388 FW at Hill AFB, Utah is exactly the kind of innovative process improvement program the USAF is looking for. With streamlined processes, reduced manpower requirements, better cannibalization/phase management, improved products, increased training opportunities for maintenance personnel and a significant improvement in the bottom line – i.e. key maintenance metrics – the program is an outstanding candidate. The timing for implementation of this type of program throughout the USAF could not be better.

Another initiative the Air Force has implemented is the reduction of its force by more than 40,000 personnel by the year 2011. The most expensive commodity the USAF has is personnel. For every 10,000 personnel cut from the Air Force ranks, it is estimated the USAF will save $1 billion. With 40,000 personnel cut over the next five years, the USAF predicts it can save more than $4 billion and use that money to fund current and future acquisition programs like the F-22, F-35, KC-X tanker and a new long-range bomber. Initiatives like a consolidated Phase and cannibalization program at every fighter, bomber, cargo, and special mission aircraft wing could alleviate the strain of a drawdown by maximizing the efficiency of the reduced maintenance force that will result from the USAF drawdown.

Air Combat Command's current initiative to reduce flying hours by ten percent across the board is another sign of the USAFs desire to cut costs. Rising fuel costs are costing the USAF millions to produce training sorties for pilot proficiency. Faced with this fact, a decreasing budget, and a global war on terror with no end in sight, ACC is assuming great risk to pilot proficiency by reducing the flying hours available for training. Anywhere the USAF can find cost savings should be addressed, assessed and if warranted – pursued to avoid unnecessary risk. The consolidated phase and cannibalization program is one of these programs.

Recommendations

The statistical results assessed in this thesis coupled with the second and third order benefits associated with the program led me to conclude that the consolidated phase and cannibalization program is worthy of implementation throughout the fighter community at home station aircraft bases where multiple squadrons of the same type of aircraft operate. I also suggest the USAF conduct a feasibility study for implementation of this program, or one similar in nature, in the bomber, cargo and special mission aircraft communities. Lastly, I suggest the USAF contract a manpower and cost savings study to assess the full value gained by implementation of this program.

[1]Will Daniel, “Logistics Officers Given Challenge at Conference” [article on line] available from http://www.af.mil/news/story.asp?ID=123028854; Internet; Accessed 15 April 2007.

[2]Air Force Website, Air Force Smart Operations for the 21st Century Office.

[3]Ibid.

[4]Ibid.

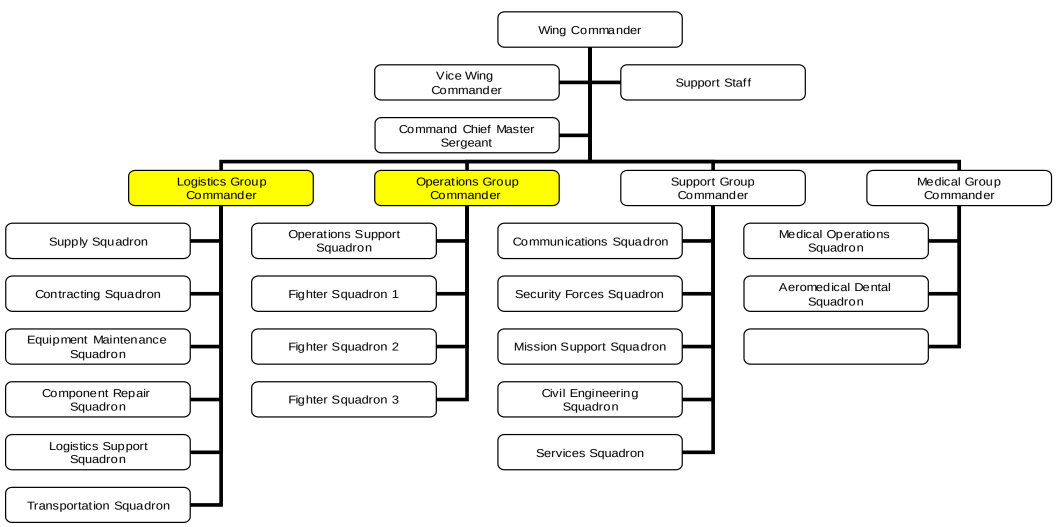
APPENDIX A

AIR FORCE ORGANIZATIONAL CHARTS

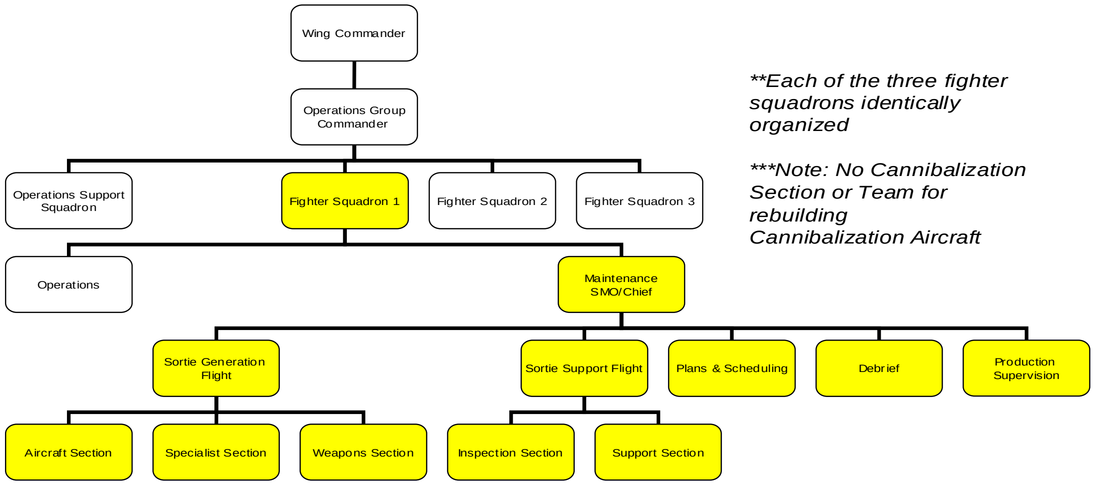
Consistent with my goal of Chapter 1, I attempted to provide an understanding of the Air Force's organizational construct and operation of the typical fighter wing throughout various times in the last 15-20 years. Unfortunately, as the Air Force made these organizational changes the documents that contained the organizational charts and structures were also changed. As a result, I had to recreate the charts below from memory, and experience as an Air Force Officer and Aircraft Maintainer for the last fourteen years. Any incongruence with actual publicized Air Force documents is merely the fault of the researcher.

Objective Wing Organizational Structure

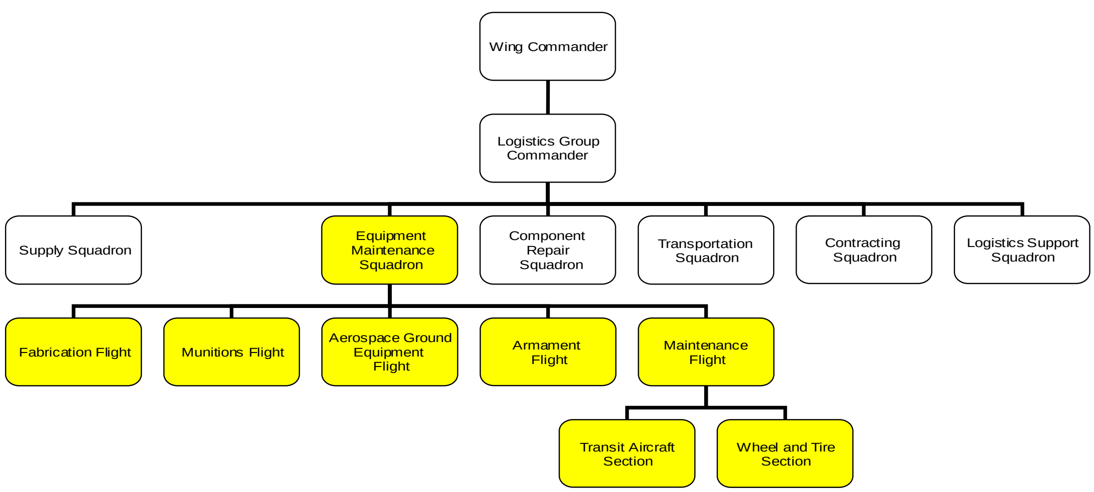
(Prior to 1 October 2002)



Objective Wing Organizational Structure (Cont)
(Prior to 1 October 2002)

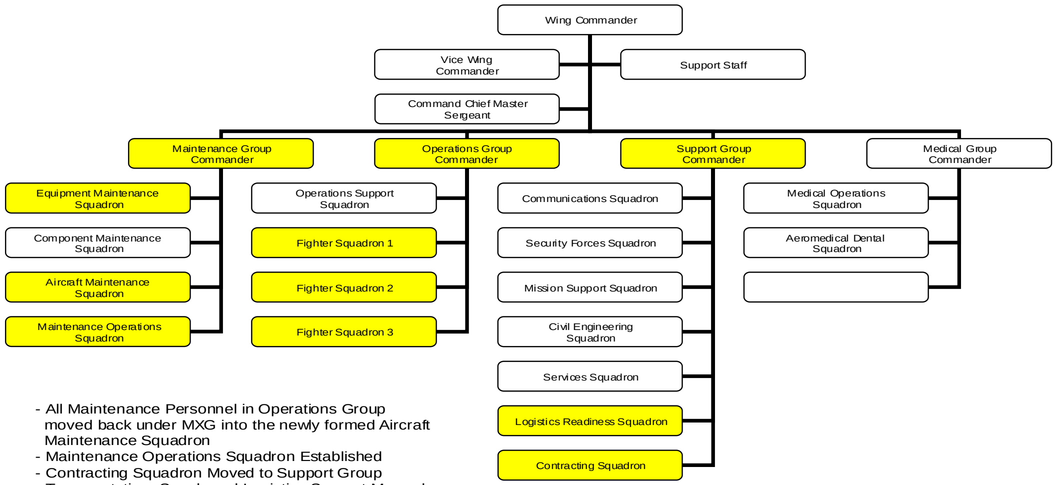


Objective Wing Organizational Structure (Cont)
(Prior to 1 October 2002)



Combat Wing Organizational Structure

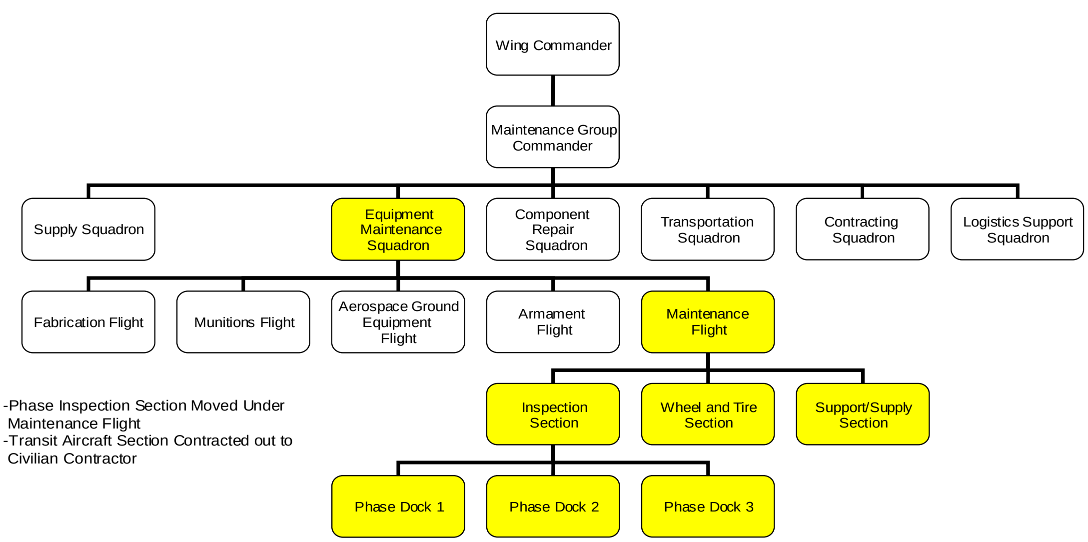
(Present)



- All Maintenance Personnel in Operations Group moved back under MXG into the newly formed Aircraft Maintenance Squadron
- Maintenance Operations Squadron Established
- Contracting Squadron Moved to Support Group
- Transportation, Supply and Logistics Support Merged into LRS and placed under Support Group

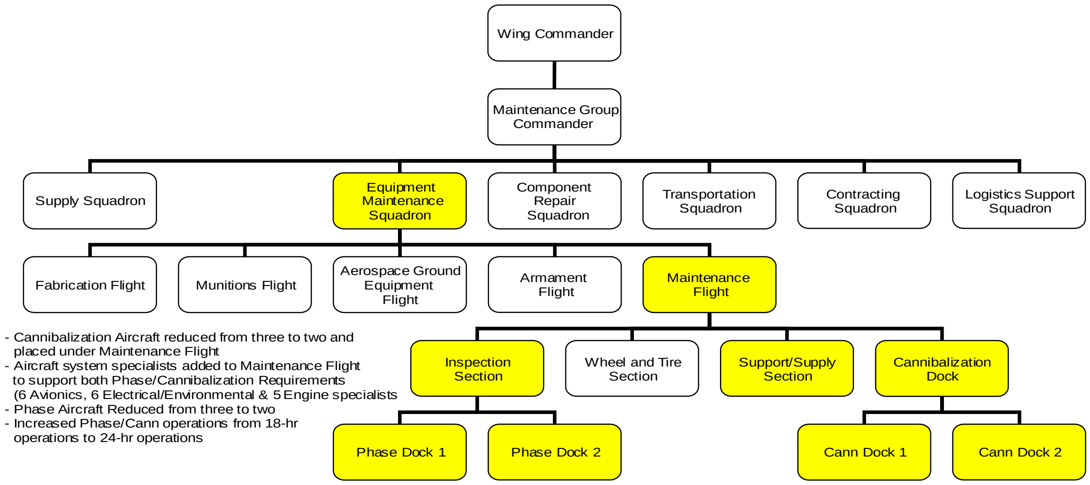
Combat Wing Organizational Structure (Cont)

(Present)



-Phase Inspection Section Moved Under Maintenance Flight
-Transit Aircraft Section Contracted out to Civilian Contractor

388 Fighter Wing Organizational Structure
(Present)



APPENDIX B

ACC VS. 388 FW METRICS

ACC vs 388 FW (Specific) Metrics

ALL F-16	FY01	FY02	FY03	FY04	FY05	FY06	AVG FY01/02	AVG FY03/06	DELTA
MC	79	79.1	81.5	84.7	85.8	81.4	79.05	83.35	4.3
TNMCM	13.7	14.1	12.1	10.2	9	13.2	13.9	11.13	2.77
TNMCS	11	10.2	9	7.1	6.5	7.2	10.6	7.45	3.15
BREAK	9.8	10.7	11.9	10.1	10.8	12.1	10.25	11.23	0.98
8 HOUR FIX	78.8	77	77	78.8	80	75.1	77.9	77.73	0.17
ABORT	5	5.3	5.9	6.2	6.1	6.2	5.15	6.1	0.95
FSE	76.6	80.4	80.7	78.4	81	76.1	78.5	79.05	0.55
CANN	9.2	8.4	11.6	7.7	6.6	5.5	8.8	7.85	0.95
Rep/Rec					4.4	4.5			

388 FW	FY01	FY02	FY03	FY04	FY05	FY06	AVG FY01/02	AVG FY03/06	DELTA
MC	73.9	76.1	78.4	82.8	86.5	82.5	75	82.55	7.55
TNMCM	17.7	17	15.4	13.2	9.3	12.9	17.35	12.7	4.65
TNMCS	13.1	9.9	10.1	7.1	5.8	6.4	11.5	7.35	4.15
BREAK	9.2	10.3	10.2	9.8	10	13.1	9.75	10.78	1.03
8 HOUR FIX	69.3	68	68	77.3	79.8	73.6	68.65	74.68	6.03
ABORT	5.4	6.3	6.2	7.1	6.2	6.8	5.85	6.58	0.73
FSE	71.9	73.4	76.8	74.7	82.7	78.6	72.65	78.2	5.55
CANN	9.7	9	13.8	7.9	7.3	5.8	9.35	8.7	0.65
Rep/Rec	6.3	7.7	5.4	4.5	3.7	3.9	7	4.38	2.62

388 FW	ACC	Delta	388 FW or ACC
7.55	4.3	3.25	388 FW
4.65	2.77	1.88	388 FW
4.15	3.15	1	388 FW
1.03	0.98	0.05	Neutral (Negative for Both)
6.03	0.17	5.86	388 FW
0.73	0.95	-0.22	388 FW (Negative for Both)
5.55	0.55	5	388 FW
0.65	0.95	-0.3	Neutral (Positive for Both)
2.62			

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